OCTOBER 20, 1958 PRICE 50 CENTS

R&D RESEARCH and DEVELOPMENT news issue

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

NUMERICAL CONTROL AND THE DESIGN ENGINEER

DESIGNING A PRODUCT— THEN AND NOW... see page 26

E B POWER GS D
UNIVERSITY MICROFILMS 1
313 N 1 ST
ANN ARBOR MICH A

DESIGN WITH FLAIR...

Refreshing design idea . . . bathroom accessories of lasting luster. Nickel plating underneath chromium prevents base metals from corroding, cleaning is easier.

A hot idea . . .
Durable chrome with good extra thick layers of Nickel underneath for lasting beauty.

Timing is perfect for lustrous chrome finish. Heavy Nickel plating underneath provides a bright metal foundation.

Nickel, under chrome, over base . . . Chrome gives you beauty. Nickel plating makes the beauty last. Base material suits economy. Information? **Write:** THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

AND AN EYE TO WEAR

NICKEL PLATING UNDER CHROME

Inco Nickel *makes metals perform better longer*

the

Patent Debate

continues

in

Product Engineering

- **"The Little Man Can't Protect His Patents"** started it all (July 28, p 26).
- Readers wrote, phoned or just plain fumed at the author . . . resulting in a complete POINTS OF VIEW devoted to their letters (Sept 22, p 38).
- In this issue editors asked four prominent patent experts, **"When is an idea worth patenting?"** (p 28).
- And the November 3 issue will carry a patent attorney's advice, **Making Money with Patents is Tough— But Not Impossible.**

DON'T MISS IT!

coming next week . . . the DESIGN issue for October 27

FEATURING

- **Alternate four-bar linkages**
  How to find the two usable substitutes that will produce the same desired motion.
- **7 Closer looks at mechanical properties**
  Stress properties that seem hidden are right in the test data.
- **Copy those drawings on microfilm**
  How miniaturization can reduce costs and add engineering work space.
- **Numerical control—what it's doing**
  How the machines actually operate, with a step-by-step example.
- **Flat belts for adjustable-pitch pulleys**
  Segmented belts combine lateral stiffness and lengthwise flexibility.
- **15 Adjusting devices**
  A selection of basic arrangements that provide and hold mechanical adjustment.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R&D Research and Development news issue

October 20, 1958 Vol. 29, No. 43

FEATURED:

DEPARTMENTS:

SIDELIGHTS 2

HORIZONS 13

SIGNIFICANT COMPONENTS 30

NEW LITERATURE 35

PUBLISHER'S POSTSCRIPT 36

FYI PERSONAL 37

WHY NOT R & D? 38

TECHNICAL EVALUATION OR POLITICS? How are decisions made when an economy wave hits rival weapon projects? 15

NUMERICAL CONTROL AND THE DESIGN ENGINEER. How his methods will be affected by latest manufacturing techniques 23

TRENDS IN APPEARANCE DESIGN. Designing a product—then and now 26

POINTS OF VIEW. Four prominent patent experts discuss: When is an idea worth patenting? 28

FIELDS OF INTEREST:

MATERIALS:

New laminate is flame-retardant, low in cost 5

Plastic bond needed for future missile casings 7

Magnetic materials coming to market 11

Pigments protect products from heat, light, ozone 11

PROCESSES:

Radioactive waste disposal worries reactor builders 8

Coatings to protect molybdenum and columbium 11

Automation in Red China moving fast . . . . . N

ELECTRICAL:

Transistorized intercom operates on batteries 8

Reactor ratings—electrical or thermal? 10

30 million character storage in British computer 21

DESIGN:

Reactor miniaturization may lead to aircraft propulsion 5

Small car designed in Holland headed for Canada 8

Nuclear energy needed for moon trip 10

Predict aluminum engines lighter cars 17

Copter tail rotor has variable speed 18

TEST:

Refrigerant lubricant qualities under study 5

Torsional vibration measured by strain gage 8

GOVERNMENT:

Defense contractors granted "proprietary rights" protection 7

Small Business to get easy government capital 7

Product Engineering ..... SIDELIGHTS

R and D RESEARCH and DEVELOPMENT news issue

ALBERT HAUPTLI *publisher*

ELMER J TANGERMAN *editor*

ROBERT W CARSON *managing editor*
ROBERT E ABBOTT *senior associate editor*
RICHARD M KOFF *senior associate editor*

PAUL N ANDERSON *associate editor*
JOHN KOLB *associate editor*
NICHOLAS CHRONIS *associate editor*
FORD R PARK *associate editor*
ROBERT S PRENTISS *associate editor*
ANNESTA R GARDNER *associate editor*
WILLIAM GILMAN *associate editor*
FRANKLIN D YEAPLE *associate editor*
JOSEPH J KELLEHER *associate editor*

BENEDICT A LEERBURGER, JR *assistant editor*
DOUGLAS C GREENWOOD *assistant editor*
PHYLLIS B SWEED *assistant editor*
DORA K MERRIS *assistant editor*
HERBERT KEE *assistant editor*
CHARLES J LYNCH *assistant editor*

FELIX GIORDANO *Detroit*
JACK MEYER *Los Angeles*
SETH PAYNE *Washington*

RICHARD E ROOMAN *art director*
E G LOADER *assistant art director*
ANGELA M GIACIN *assistant*

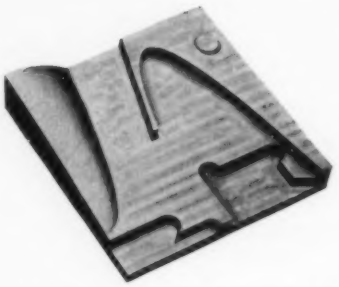
NORMA J VAN NESS *production supervisor*
LILLIAN M WITHAM *assistant*

JOSEPH KERR *consulting editor*
ROBERT E BRUCKNER *consulting editor*

DEXTER KEEZER *director, economics dept*
GEORGE B BRYANT, JR *Washington*
DONALD MacDONALD *Detroit*
WILLIAM G MELDRUM *Cleveland*
STEWART W RAMSEY *Chicago*
MARGARET RALSTON *San Francisco*
JOHN H KEARNEY *Los Angeles*
MICHAEL J MURPHY *Los Angeles*
RAY BLOOMBERG *Seattle*
CHARLES T DIXON, JR *Atlanta*
KEMP ANDERSON, JR *Dallas*
JOHN WILHELM *editor, world news*
JOHN TUNSTALL *London*
JOHN SHINN *London*
GENE DI RAIMONDO *Milan*
RAYMOND SHAH *Zurich*
WILLIAM COUGHLIN *Moscow*
ONNIC M MARASHIAN *Beirut*
PETER WEAVER *Mexico City*
JOHN PEARSON *Caracas*
SILKE BRUECKLER *Bonn*
SIDNEY MORRISON *Bonn*
SOL SANDERS *Tokyo*

STANLEY J ALLING *associate publisher*
PHILIP G WEATHERBY *advertising sales manager*
P F PRITCHARD *manager, market research*
ROBERT C MATTOON *circulation manager*
C C KANE *reader service manager*
RUSSELL T DOUGLAS *business manager*

● **Numbers will always fascinate us,** whether as an elegant means of machine control (p. 23) or in the form of statistical inquiry. For example, the *Kaiser Builder* writes of a Lloyds of London survey of paper clips purchased in Britain. The result: 24.6% dropped on floors, left in drawers, and swallowed by children; 19.4% as stakes for card games; 14.2% twisted and broken during phone calls; 7.2% to repair women's garters and bras; 5.4% as toothpicks and ear scratchers; 5.3% as nail cleaners; 3.9% as pipe cleaners; 20% as paper clips. These figures seem about right, but we have another question: Four years ago our secretary filled the little compartment in our desk drawer and we are prepared to swear that no clips have ever been added to the supply. We use at least 10 paper clips each day, but the compartment is still full. Friendly gremlins?



● **You'd think nothing ever goes wrong** in scientific experiments if you read the published papers, and this is particularly true in the nuclear field where serious problems threaten (pp. 8 and 10). Therefore we were fascinated by a Geneva paper by Dr. A. Hollaender describing experiments to determine the effects of radiation on mice. In one experiment, a cat ate some of the irradiated mice at a critical stage of exposure. When asked what happened to the cat, the author said it had "given its life for science." Not exactly a voluntary contribution, of course.

● **A reader's letter** published in the Sept 8 issue insisted that handwriting analysis was probably the best and certainly the cheapest way to handle personnel selection. Since then we have received five letters and a phone call from responsible engineers requesting the name of a good graphologist. As a result, several heated discussions have developed among the editors, with opinions ranging from "downright nonsense" to ". . . might be something in it." In any case, no one sends handwritten notes any more.

ABP OCTOBER 20, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 43 ABC

PRODUCT ENGINEERING is published weekly,—with an additional Design Digest Issue in Mid-September, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and consultants engaged in the design of machinery and the other engineered products. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

United States subscription rates for individuals in the field of the publication, $5.00 per year, single copies 50 cents; Canadian subscription $7 per year; foreign $25 per year, payable in advance. Second-class postage paid at Albany, N. Y. U.S.A.

©Copyrighted 1958 McGraw-Hill Publishing Company, Inc., all rights reserved.

PRODUCT ENGINEERING articles are indexed in both the **Industrial Arts Index** and the **Engineering Index.** PRODUCT ENGINEERING publishes its own semiannual index including the Design Digest Issue. Copies are obtainable on request to the Editor.

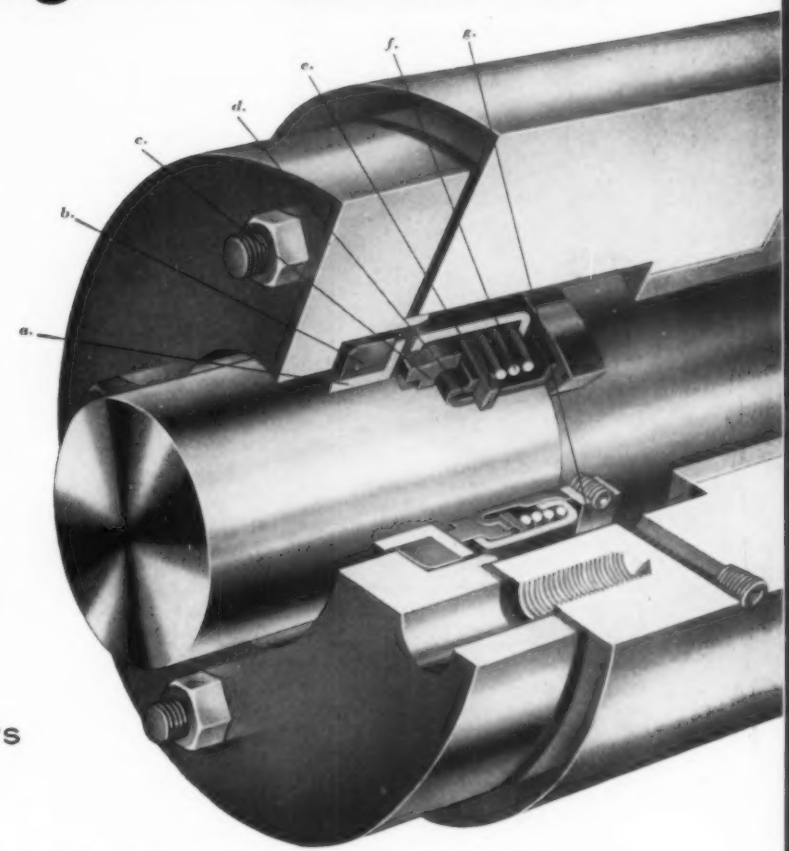
SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address giving old as well as new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

Postmaster: Please send form 3579 to PRODUCT ENGINEERING, 330 W. 42nd St., New York 36.

MORE OF THE GARLOCK **2,000**

No More Stuffing Box Maintenance!

Install Garlock Package Seals on Your Present Pumps



- ELIMINATE LEAKAGE AND SHAFT WEAR
- REDUCE DOWNTIME
- CUT MAINTENANCE COSTS

When leakage and maintenance are serious problems in the operation of your pumps you'll find a perfect answer in Garlock MECHANIPAK* Seals. Installation on new or existing equipment is simple. And, several designs are available to meet a variety of operating conditions: pressures to 150 psi, temperatures to 212° F., and shaft speeds to 2000 feet per minute. Sizes for shafts from 3/8" to 3" diameter for sealing against water, oils, alcohol, mild acids and solvents.

MECHANIPAK Seals are another important part of "the Garlock 2,000"... two thousand different styles of packings, gaskets and seals for every need. It's the only complete line ... that's why you get unbiased recommendations from your Garlock representative. Ask him for complete data on this long-life, maintenance-free MECHANIPAK Seal. Or write for Folder AD-150.

a. ***Stationary Seat*** *of ceramic, Ni Resist, or bronze has precision lapped sealing face for perfect contact with carbon ring.*

b. ***Vibration Ring*** *of Buna-N positions stationary seat in a flexible mounting and acts as static seal.*

c. ***Seal Ring*** *of carbon is also precisely lapped to match sealing face of stationary seat.*

d. ***Roll type Bellows*** *permits free movement of seal ring.*

e. ***Shell,*** *encases entire rotary unit and furnishes mechanical drive for seal ring.*

f. ***Stainless Steel Spring*** *with load precisely calculated to face area of seal.*

g. ***Stop Collar,*** *or shoulder, positions seal to specified operating length.*

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

*Registered Trade Mark

CIRCLE 51 READER SERVICE CARD

How can CREATIVE WOOD ENGINEERING help you?

- Research in improving present wood products?
- Development of new wood products?
- Research in completely new "wood-combination" materials?

If your problem involves wood (and maybe it should) Gamble can help! Gamble Brothers' 65 years of creative wood engineering has greatly expanded the usefulness of America's great renewable resource. Gamble has pioneered new processes and new products involving wood-and-fiberglass, wood-and-plastic, wood-and-metal, wood-and-synthetics and countless others. Perhaps our technical knowledge of the properties of more than 130 commercial wood species, and the creative application of this knowledge to today's design and development problems could be of service to you.

Send for FREE booklet Illustrating GAMBLE services

This 28-page booklet describes Gamble facilities and services in detail. Includes many photographs of unusual products designed, tested and perfected by Gamble Brothers. Write for your copy today! Gamble Bros., Inc., 4617 Allmond Ave., Louisville 9, Ky.

GAMBLE BROTHERS
Incorporated
Louisville 9, Kentucky

READER TO EDITOR

Thanks from Moscow

• These two letters came from engineers in Moscow. They both arrived unopened and, to the best of our knowledge, uncensored.—Ed.

To the Editor:

I am very grateful to you for your letter and for the copy of PRODUCT ENGINEERING you sent, the one devoted to your account of your stay in the Soviet Union. Your letter again reminded me of our pleasant get togethers and I am happy that my assistance to you turned out to be useful.

I offer apologies for my delay in answering, but for the last month and a half I was not in Moscow and I received your letter and magazine only today. From the 10th of August I was taking my summer leave and was resting at a resort.

A cursory going-over of your magazine does not permit me to make critical comments. But it seems that the material you published offers things of interest for the readers of the magazine and, in spite of your short stay in the Soviet Union, the published account is very broad.

I am happy that my gifts pleased your wife and that you saw fit to mention them in the published account. Please send my regards to your family.—A. GRECHUKHIN
Personal Assistant to Director,
Moscow Area Economic Council

To the Editor:

Thank you for sending me a copy of PRODUCT ENGINEERING (July 14) containing the story on ENIMS, our high-evaluation institute. —A. E. PROKOPOVICH
Chief Engineer
Experimental Scientific Institute
for Machine Tools

• This poem on Russian technology was submitted by a reader who got it from East Germany. He prefers to remain anonymous.—Ed.

Keine Bretter für die Lauben
Für das Auto keine Schrauben
Für den Hintern kein Papier
Aber Sputniks haben wir.

No boards for the house,
No bolts for the car
No toilet paper
But Sputniks we have.

The French Way

To the Editor:

Your Points of View, "The Little Man Can't Protect His Patents" (Sept 22, p 38) raises a very important question with respect to the difficulties encountered by an inventor deprived of large financial means for the working of his inventions. My position at the head of a French company, manufacturing industrial equipment, enables me to be well aware of the importance of research as well as inventions and to understand the extent and limits of the advantages that a patent has to ensure to the inventor.

I do not share the opinion of the writer of that article when he finds it normal for an inventor paid by a company for technical research to keep in his possession patents which constitute a contribution of the company employing him. Such is not the case in France where the patents (we call them "brevets") are handled in a particular way. In the USA, it is wiser for an inventor not to try to be covered by patents since they just invite problems.

A remedy would require improving three different situations: (a) American laws are too restrictive against inventors as regards descriptions and protection of patents, (b) amount of law costs and attorneys' fees is too high—the inventor being under obligation to pass through the intermediary of attorneys (a monopoly not existing in France), (c) the situation created by a kind of power trust of big companies, which all agree to refuse to act towards the inventor, needs correcting. Otherwise, he faces a dilemma—unable to work his invention, or to draw very little profit from it. —CHARLES HEURTEY
President, Heurtey et Cie

American...

DEVELOPMENTS TO WATCH...

Lubricating abilities—and disabilities . . .

. . . of refrigerants are getting a close look as operating temperatures of industrial as well as military equipment rise. Reports in some cases are surprising and apparently contradictory.

At the ASME-ASLE conference, for instance, Stanley Gray of Fairchild Engine & Airplane Corp reported a study of bearing lubrication with Freon 12 that gave it a good recommendation for use as a liquid-phase lubricant (at low temperatures), but cast doubt on its effectiveness as a vapor-phase (elevated-temperature) lubricant. At low temperatures, there was some sliding wear on the retaining rings, but this is overcome by adding 1 or 2% of petroleum oil (VV-L-825) to the liquid Freon.

But as a vapor-phase lubricant (for temperatures above 110 F), he labels Freon 12 "not feasible," even when stainless steel balls and retainers are used; and when 52100 steel balls are used with bronze, monel, or silver retainers, "excessive retainer wear occurs and no evidence exists of a lubrication film."

On the other hand, at the ACS meeting in Chicago, Donald Buckley of Lewis Flight Propulsion Laboratory reported that Freon-type gases can do a good job of lubricating nickel and cobalt alloys at temperatures to 1200 F—under some conditions. The key, of course, is the specific design application, and the Freon-type compounds look promising enough at least to rate consideration.

Reactor miniaturization and mechanization . . .

. . . promise more efficient power plants and smaller weapons, open new opportunities for designers of mechanical parts, and may eventually provide a long-sought breakthrough on aircraft propulsion.

At the UN Conference on Peaceful Uses of Atomic Energy, French scientists described a tiny homogeneous reactor that operates on a mass of plutonium weighing "barely as much as a cup of sugar" (a little over half a pound); and US scientists described reactors that "might be used to propel rockets, ships or aircraft," yet are only a fraction of the size of present-day nuclear powerplants.

At the same time, an AEC report, prepared by Dr. W. H. Zinn of General Nuclear Engineering Corp, describes an unusual turret-type reactor designed by Los Alamos National Laboratory. This unit has a core that indexes just the way the turret of a machine tool operates. The aim: to simplify loading and unloading of nuclear elements and eliminate the need for the myriad holes on the conventional reactor face by which individual elements are inserted and removed. This reactor has other interesting features as well. It uses nitrogen at 500 psi as a coolant and the working fluid for a direct-connected gas turbine, and is expected to have an over-all efficiency of 30.2%.

Low-cost, flame-retardent XXXP laminate . . .

. . . said to have excellent electrical properties and moisture resistance, has been developed by National Vulcanized Fibre Co., Wilmington, Del, and is now ready for evaluation.

The new material is a warm-punching (130 to 150 F), paper-base phenolic that qualifies as Class A electrical insulation, stands the UL direct-flame test for at least 1 to 1½ sec, and has fair mechanical strength. Major uses are expected to be in copper-clad materials for printed circuits and the like, and the price will be "just slightly above" that of the standard XXXP grade.

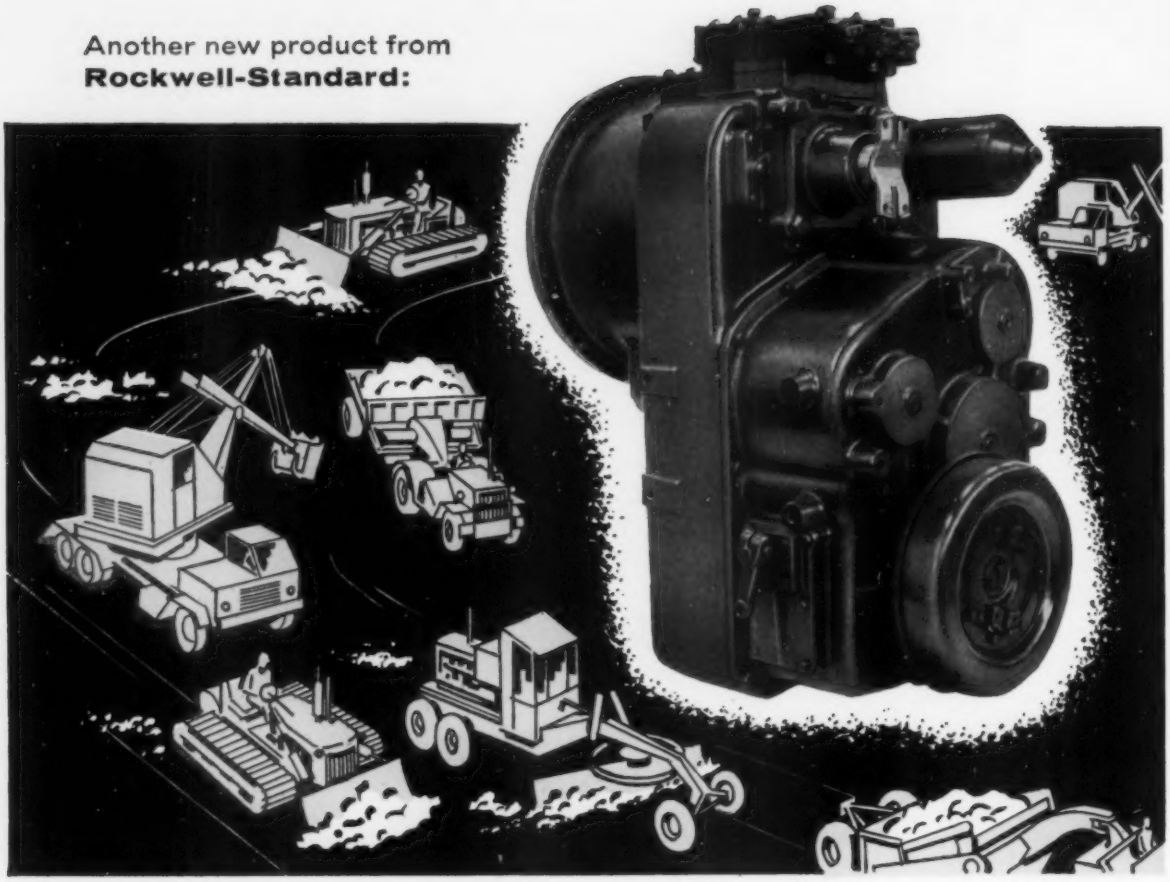
Tougher coatings that dry faster . . .

. . . are promised by research on an "old" material, tung oil, at the Department of Agriculture's New Orleans laboratory.

Tung oil, as the USDA points out, has long been valued for its fast-drying properties, but it lacks the chemical and fungus resistance of the more-modern synthetics.

Now, though, using a new catalyst and new additives, USDA researchers have produced both alkyd and epoxy-based tung oil coatings which are not only faster-drying but also show improved resistance to water and alkalis, and to rot and mildew. The new coatings are being produced in pilot plant quantities, and industrial evaluation is under way. —ARG

Another new product from
Rockwell-Standard:



HYDRA-DRIVES®
POWER SHIFT TRANSMISSIONS

A torque converter...and 4 speed transmission in one compact package!

Hydra-Drives Power Shift Transmissions put *more* power to work . . . smoothly . . . efficiently . . . economically. Proved in hundreds of vehicles for three years, these units assure top work output of heavy-duty equipment. Engine lugging and heavy shock loads are eliminated. A 3 to 1 torque multiplication makes starting fast and effortless—even with heaviest loads.

Simple to operate, too, a flip of the operator's lever accomplishes power shifts within each range and without any interruption of the power flow. Automatic features of the converter and ease of power shifting simplifies operator training and lengthens vehicle life.

With four speeds forward and reverse, the Hydra-Drives Power Shift Transmission is ideally suited for vehicles which must travel in both directions during a normal work cycle. Rated at 550 ft. lbs. input torque, they can be used with a wide range of internal combustion engines up to 250 H. P.

The Transmission and Axle Division of Rockwell-Standard specializes in drive components only, and *does not compete with manufacturers of end products.* Take advantage of 50 years' experience in the manufacturing of power transmission components, specify Rockwell-Standard.

HYDRA DRIVES
ROCKWELL-STANDARD CORPORATION
TRANSMISSION AND AXLE DIVISION
DETROIT 32, MICHIGAN

©1958, R-S Corp.

Products of **ROCKWELL-STANDARD** Corporation

American ...Washington

DEVELOPMENTS TO WATCH...

More protection on "proprietary rights"...

has been given defense contractors. New regulations that have been awaiting an announcement will cover manufacturing methods or processes, treatment and chemical composition of materials, plant layout and tooling, and other such manufacturing secrets.

The Pentagon has had pretty much of a blanket requirement for such information. But now, contracts will spell out in detail the amount of technical data to be furnished. There are three important changes in the new regulations:

1) In general, contractors won't be required to provide proprietary data for so-called standard commercial products the government buys under advertised procurement.

Exception to the rule will be only when a "clear government need . . . is established" and spelled out in bid invitations. Trade secrets will then be covered by "specific negotiation for such data and the contractual requirement shall be listed separately."

R & D contracts will require the contractor to furnish the military with "all data resulting directly from the project." But, on standard commercial products bought for R & D projects, instead of formal proprietary information, the contractor may only furnish details on performance specifications, sources, and other facts which would allow the military to "practice the process or to procure the part of an adequate substitute."

2) This change specifically exempts from the proprietary-data requirement any products used as components in R & D models developed at private expense and previously sold on the open market.

3) A new clause will be added to all military supply contracts, stating that contractors do not have to provide proprietary data if the specifications are outlined in the contract—unless specifically called for.

Plastic bond for missile casing . . .

is being pushed hard. According to reports, reason is that the military needs a thin, strong structure to house the high-flying supersonic missiles, and welded construction leads to brittleness in the high-strength metals.

Aerojet General, working on a Navy contract, is exploring spiral-wrap construction that is bonded with an organic resin. This is based on a British patented process, with most of the information classified. Aerojet claims to have run several successful static tests on the process.

Several other companies are working in the same field: some trying spiral-wrap construction; others experimenting with laminated metals.

A big stumbling block is that organic resins break down when temperatures climb much over 300 F. But National Bureau of Standards is trying to solve this problem. Also, it is working on ceramic bonds that can take the higher heats. Still another problem in both laminated and spiral-wrap construction is how to attach the missile head to the casing.

Pentagon missile experts, however, claim that the missiles of the future will be built with one of these new types of construction.

The little business firms . . .

that is, those qualifying as small business under government rules, are in line for easy government-stimulated capital on long-term loans.

Congress set up an investment structure this year designed to aid small companies. It established a $250-million revolving loan fund to be subscribed to by financial houses and others who have previously shied away from this type of investment. In turn, the investment companies are to loan money to the small business firms, with interest rates set at state maximums. And, loans can be made for 10 years —with a 10-year extension.

Response to the new law has been overwhelming, attracting big-time investors who originally weren't expected to respond. Now the Small Business Administration is saying that literally billions of dollars are going to be thrown open to small firms for expansion, modernization, etc.

The reason is simple. Congress wrote into the law very attactive tax benefits for the big-time lenders. And they are swamping the SBA for information on how to set up small-business investment programs. Guide rules for government control will be announced early next month. After this, the Small Business Administration expects money to begin flowing to the qualifying companies.

World-wide ...

DEVELOPMENTS TO WATCH...

Transistorized intercom . . .

. . . that will sell for about $50, operates on two 4.5-v dry cells, has been designed by an Austrian firm.

A six-line main station is priced at $51 (US equivalent); substations, $10.85. Several alternate designs will be produced as well; one featuring a cut-off circuit designed to prevent listening-in by other phones connected to the same line.

Reinauer & Co, Vienna 6, will be the distributor.

Disposal of radioactive wastes is worrying . . .

. . . nuclear-reactor builders all over the world. It's a problem that makes difficulties of "The Sorcerer's Apprentice" seem minor.

To be sure, suggestions for solving it are plentiful: Dump the wastes in the sea; pipe them into underground chambers; process the wastes and make use of the radioactive materials; and so on. But no suggestion to date meets all the requirements of simplicity, safety, and low cost.

For example, at the recent UN Conference on the Peaceful Uses of Atomic Energy, Canadian scientists suggested incorporating the wastes in glass, then storing them underground. Glass is a non-leachable material which is darkened but not destroyed by radiation, therefore relatively safe from this point of view. But even this "cheap" solution would add about 0.02 mills/kw to the cost of power and would require 5 to 50 acres of disposal ground a year for a 1000-mw reactor.

Right now, the primary storage system used in the US is storage in steel tanks; but no one knows how long the tanks will last—and we've already got 65 million gallons stashed away, with much more to come.

Whatever the final solution, though, it will mean a demand for new-type pumps, valves, motors and handling equipment that can not only stand up to radiation and be operated by remote control, but will also be easy to decontaminate and keep clean, and will last many lifetimes under rough conditions.

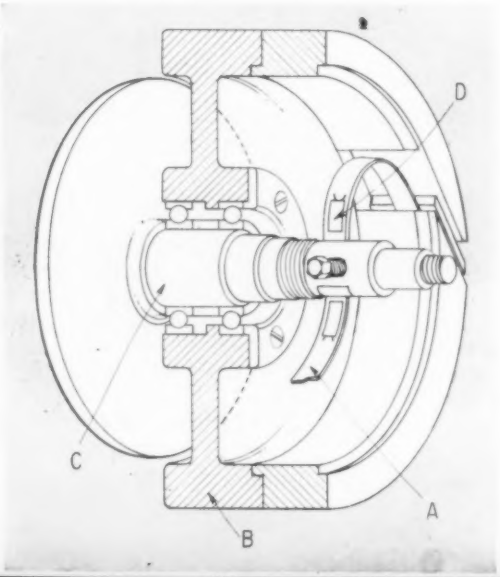
Small car designed in Holland . . .

. . . that country's first in 50 years, is now scheduled to reach the Canadian market before it gets to the US. Latest word is that "a limited number" will be shipped to Canada next year; but US distribution is "two or three years away." The car is a 2-door sedan with a tiny (2-cyl, 22-hp) engine, will be priced in the $1000 range. Manufacturer is Van Doorne Automobielfabriek NV, Eindenhoven, long a producer of commercial vehicles but never before in the passenger field.

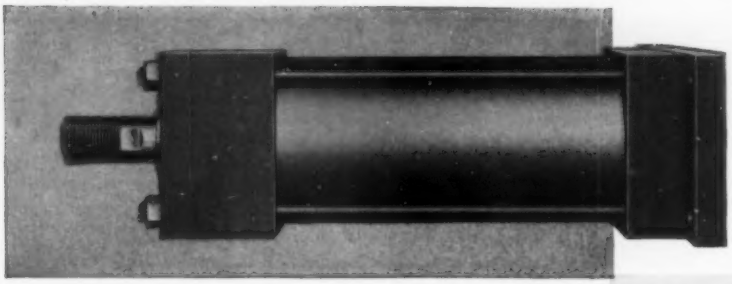
Torsional vibration is measured . . .

. . . with the aid of strain gages in an instrument developed by Fiat of Italy. It's basically similar to the Geiger torsiograph, except that it uses S-shaped leaf springs equipped with strain gages—four in all—in place of the usual mechanical amplifier and recording unit, and connects them together to form a Wheatsone bridge that feeds a recording oscillograph.

Fiat will supply two types: one for slow engines (120 to 600 rpm); the other for higher speeds (500 to 2000 rpm); and has developed a battery-operated recording unit to be used where ac is not available.



NEW TORSIOGRAPH features S-shaped leaf springs *A*, carrying strain gages *D* to record the movement given to a mass *B* rotating on a shaft *C*.

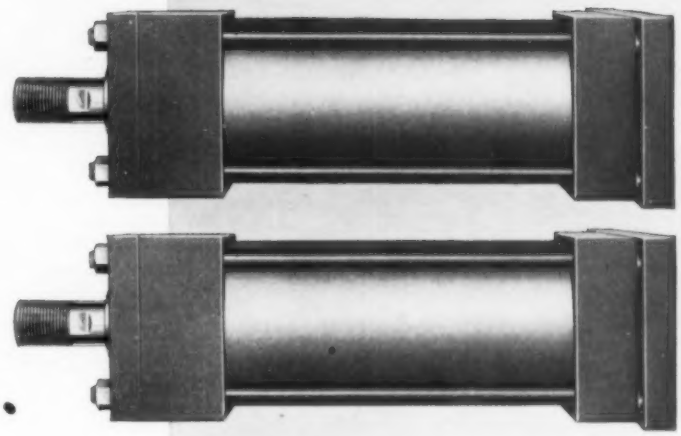


◀ A LOGANSQUARE CYLINDER

2 competitors' cylinders

▼

do they LOOK ALIKE? ...sure they do on the surface...



...BUT LOOK AT Logan's BIG EXTRA PLUS VALUES

Logansquare Cylinders

are made to interchange with other leading manufacturers' cylinders . . .

1. Logan designs assure the service required for those extra-rugged applications.
2. Over FORTY YEARS of cylinder manufacturing know-how.
3. Built by CRAFTSMEN whose average service record with LOGAN is more than 20 years.
4. Manufactured in a plant which applies the most modern production methods.

FREE

SEND FOR THE "LOGAN CALCULATOR"

MEMBER: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
812 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLINDERS
- ☐ 200-3 750 SERIES HYD. CYLINDERS
- ☐ 200-4 AND 200-7 HYD. VALVES
- ☐ 200-6 SUPER-MATIC CYLS.
- ☐ 300-1 CHUCKS
- ☐ ABC BOOKLET
- ☐ CIRCUIT RIDER

TO:

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

What's happening in SCIENCE

Riding the atom to outer space

If we are to get to the moon at any time in the reasonably near future, nuclear energy will have to supply the power. That's the concensus from laboratories all over the country. Chemical systems can't do the job; and solar energy, while attractive at first glance, will likely require far too much equipment to be practical.

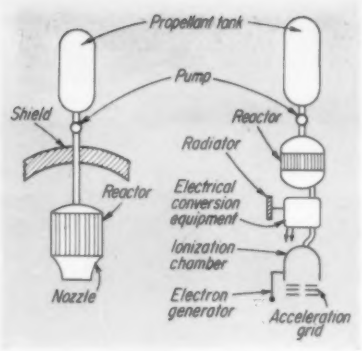
For instance, A. L. Huebner and R. H. Boden of Rocketdyne Div, North American Aviation, point out photovoltaic cells for converting solar energy into useful power would have a specific weight of about 200 lb/kw—far above the acceptable level. Thermoelectric generators would be even further out of line, resulting, they say, in a vehicle thrust-to-weight ratio that is "completely unacceptable." They also point out that difficulty in cooling the "cold" junctions of thermocouples would pose severe problems. Solar-energy collectors might prove attractive in some areas if a significant decrease in collector weight per unit area can be achieved. But that seems a long way off.

Nuclear energy, on the other hand, does offer possibility of achieving a satisfactory thrust-to-weight ratio, and considerable flexibility in application.

Right now, the two most promising ways in which it might be applied seem to be the *heat-exchanger* rocket and the *ion rocket*.

In the former (see diagram), the reactor generates heat which is used to heat and propel a reaction mass. As Dr. T. C. Merkle of the University of California's Radiation Laboratory points out, the only difference between this type of nuclear propulsion and the chemical rocket is that the "fire" is contained within the body of the nuclear reactor, instead of being produced by the combustion of propellants. There are the same problems of containing the "fire" and of finding materials that can stand the heat.

In the ion rocket, the nuclear source would generate electricity rather than heat. This, in turn, would operate an accelerator that would eject particles from the engine at high speed. This system, unfortunately, does not seem able to generate enough thrust to take off by itself; but it looks like a very good one for traveling through outer space because it would require relatively little material to keep it going.



Two most promising ways to apply nuclear power to rockets are diagrammed here by Martin Co engineers. At left is the "conventional" or heat-exchanger rocket; at right, the ion type.

There are tremendous problems in designing an ion rocket, though. As T. F. Nagey of Martin's Nuclear Div. told a recent SAE meeting, it takes about 50 kw electrical power to produce an ampere of ions with today's high-current ion jets. He feels, though, that if high-velocity acceleration can be achieved, this inefficiency will not be too serious an obstacle.

Guide to reactor ratings

Conventional powerplants may have two ratings—kilowatts or horsepower; but only one of each type. Even a gas turbine is given only one rating for each application (hp if it is hooked up to a mechanical load; kw if it is used to drive an electrical generator). Furthermore, the ratings in most cases are of the same order of magnitude. A 5000-kw gas turbine is about equivalent to a 6700-hp unit.

Not so with nuclear reactors. They have been getting two ratings, both in kw, which can lead to considerable confusion. One, roughly similar to a boiler rating, refers to *thermal* kw (tkw). This represents heat output of the reactor, converted mathematically from conventional heat units into electrical terms. The other rating is in *electrical* kw (ekw) and is the generator output. The order of magnitude of the two, as applied to a single reactor, may differ by a factor of as much as 10. Thus, a 30,000-kw reactor may be big enough to provide power for a colony of homes; or may be just an experimental unit that will generate only 5000 kw of electrical power. An "e" or a "t" in the designation should provide the clue. It's too easy to get the wrong impression when those identifying letters are missing.

briefs . . .

Barium titanate's electroluminescence is helping NBS researchers study the properties of the material itself. By analyzing the light emitted by this important piezoelectric material, they hope to obtain more information to guide its use in capacitors, sound detectors, transmitters, ultrasonic generators, and new computer "memory" devices now under development. One interesting finding: Light output jumps tremendously at resonant frequencies and at the material's curie point, though other electrical properties remain unchanged.

Recommended abbreviations for chemical, engineering and science terms are contained in a new set of data sheets prepared by the Manufacturing Chemists' Assn. Specifically designed to aid data processing, the abbreviations are 2- to 4-letter symbols based on "a combination of phonetics, chemical symbols, and common trade usage." The 8-page publication, priced at 20¢, may be had from MCA, 1625 Eye St., NW, Washington 6, DC. It's *Manual Sheet CA-1*.

American papers, prepared for the UN Conference on the Peaceful Uses of Atomic Energy, are now obtainable from the Office of Technical Services, Washington 25, DC. Individual papers are priced at 50¢, and a complete listing may be had for 25¢. (For information on availability of papers prepared by other countries, see *PE*—Oct 6, p 10). —ARG

Help for the hot spots

At least a dozen coatings have been developed to protect molybdenum and columbium at temperatures of 1500 F or more in air, says Fansteel Metallurgical Corp. One, Fansteel's own "Siliconized" coating, has given protection to moly for as long as 6500 hr at 1500 F, and nearly 30 hr at 3360 F. Another, a modified Ni-Cr alloy on columbium, was still going strong after 1000 hr at 2200 F.

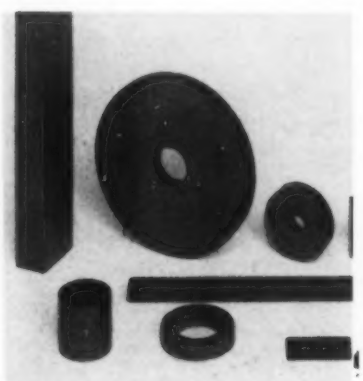
Top rating, at least as far as temperature goes, is given to a moly coating—developed by the National Bureau of Standards—that combines glass with zirconia or kaolin. It was able to provide protection for about 45 min. at 3450 F.

Others that have passed tests of 500 hr or more in the 1500-F to 3090-F range include chromizing coatings (Chromalloy), Cr-Ni electroplates (NBS), and several Ni-Si-B and Ni-Cr-Bi (Climax).

Magnetic materials come to market

Yttrium garnets, one of the fast-moving new ferromagnetic materials that were almost unknown a year ago (*PE*—Jan 27, p 14) are now available on a semicommercial (sample) basis.

Like the even-newer barium and strontium ferrites (*PE*—Sept 22, p 10) these rare earth-iron oxides are transparent in single-crystal form, make it possible to visualize changes in magnetic domains. The semicommercial material, though, is a high-density, sintered, polycrystalline material. Kearfott Co, the supplier, says it has a saturation flux density of 1800 gauss, and a curie point of 300 C. Temperature coefficient of saturation flux density is minus 3%/°C.



Rare-earth garnets, being readied as replacements for ferrite components in nonlinear electronic devices, can be pressed and ground to shape, as these samples show.

Protect 'em with pigments

Materials that deteriorate rapidly in the presence of heat, light, ozone, and even nuclear radiation can often be given a high degree of protection simply by loading them with pigments.

It's been known for some time that black-pigmented nylon and polyethylene stand up far better under ultraviolet radiation than unpigmented material (*PE*—Nov 18, '57, p 7). Now it seems the same kind of protection is afforded to phenolic, alkyd, and silicone paints and nitrocellulose lacquers exposed to heat and nuclear radiation.

Wright Air Development Center reports that black pigments can markedly prolong service life of coatings exposed to nuclear radiation. Other colors don't do as well, though. In fact, says WADC, difference in degree of protection provided by black as compared with red and white is "striking." Black-pigmented coatings can withstand as much as 1×10^8 roentgens of radiation followed by a heat treatment. Red is much less effective; white, least of all.

briefs . . .

Stickiest adhesive is claimed by B. F. Goodrich Industrial Products Co. Introducing a new group of pressure-sensitive themoplastic polymer cements, it claims they are "radically different from other rubberlike cements," will "cling and join surfaces which, in many cases, have defied adhesion until now." No other rubbery material, says C. O. Delong, company president, compares with these new resins in their inherently strong stickiness. First to be introduced commercially will be a laminating adhesive; but others are on the way.

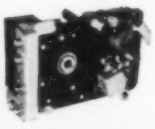
Scarcity of scarcities is highlighted by Office of Civil and Defense Mobilization announcement that the list of materials to be purchased for the stockpile on the open market is down to four: amosite asbestos, diamond dies, muscovite block and film mica. Back of the announcement is a change from a 5-year to a 3-year basis for the stockpile which automatically puts almost all the other materials over the top; plus the fact that, with few shortages during the past several years, stockpile materials have been flowing in.

New temper designations for stress-relieved aluminum alloys are announced by the Aluminum Association. A 3-digit system is used, following the letter T which indicates tempered alloys. The first digit indicates basic temper; the second is a specific for stress relief; the third indicates type of stress-relieving treatment. A typical example is 2024-T351. This is solution heat-treated plate (3), stress-relieved (5), by stretching (1).

Aluminum's electrical progress is highlighted by an Alcoa exhibit which shows products from more than half a hundred companies, ranging from magnetic limit switches to induction-motor rotors, now being produced commercially by more than half a hundred manufacturers. The collection will be on display at the Alcoa building during the AIEE meeting in Pittsburgh, the last week of this month.

Free-machining steels are getting better all the time, says La Salle Steel Co. Since introduction of its Stressproof series about two years ago, the company says, tolerances have been tightened, yield strength increased, and machinability boosted. The company now guarantees a yield strength of 100,000 psi for bar stock (as received) and standard tolerances of 0.004 (on sizes to 1½ in.) to 0.006 (on sizes above 2½ in.). —ARG

Hummingbirds Are Power-Packed...have more energy for their size than an elephant. Smallest hummingbird is only 2⅜″ long, builds a nest only 1″ square with cobwebs. The hummingbird is one of nature's greatest masterpieces in miniaturization.



Miniature Tape Recorder fits in briefcase . . . operates on hearing-aid batteries yielding 1/8000 h.p. This is possible because friction is reduced by two MPB bearings installed on the main drive shaft. Another man-miracle in the world of miniaturization.

Man With Miracles. This is Bill Timmerman, one of MPB's Sales Engineers. He helped the tape recorder people find exactly the right type of bearing to reduce friction to a minimum, give failure-proof service and help keep original and maintenance costs low.

More Miracles in Miniaturization to come

BEARING ACTUAL SIZE

It's just starting. Industry is on the threshold of new miracles in the world of miniature mechanisms. Best help in the problems will be MPB who has the world's greatest wealth of experience in the application of miniature bearings ⅜″ O.D. or less. MPB has more than 500 types and sizes, specials on request, engineering and research facilities second to none. You'll want to know more about miniaturization and the promise of progress it holds. For engineering aid and/or new catalog write **Miniature Precision Bearings, Inc.,** 210 Precision Park, Keene, N. H.

MPB

Helps you perform miracles in miniaturization

Product Engineering HORIZONS

October 20, 1958

Chief Salesman?

There is an old story about the aged storekeeper who lay dying, with his family gathered about him. One by one, his children were brought to the bedside to say farewell, and his wife ended the parade by assuring him they'd all stay right there with him. At which he summoned the last of his failing strength and shouted, "Who then is tending the store?"

The answer then—and in too many engineering departments—is *nobody*. Too often, the top engineering talent is out making sales. It may be a subtle approach, of course, that impresses the customer no end, and the top engineering talent may no longer be handling active management except in name. But in more cases than not, the engineering work piles up while the best problem solvers are out impressing people.

True, some of the equipment being bought, sold or discussed is quite complex and/or very confidential, so there's an understandable desire to keep the information within the smallest possible group. It's also true that no one knows —or should know—better than the top engineer what his organization can do, how long it will take, how much it will cost. And true that it may be necessary to swap ideas at a high level of knowledge to get the job done at all. And lastly, but not by any means least, a company must have orders to stay in business.

But that's what the sales department is for. Or used to be. The greater complexity of modern products means greater complexity in engineering design and management just as surely as it complicates selling. The engineering department really needs intelligent, skilled and experienced management under today's conditions. Most departments are set up that way—with the pyramid of authority topped by presumably the best man in the outfit. If he's selling, or consulting, or otherwise involved in many non-engineering activities, he cannot exercise the close control his job requires. The result may be an excellent front backed by poor engineering—like the storefronts in some movie set.

We do not advocate a cloister for the engineers, or even for the top echelon —too much cloistering takes them away from reality. But too much top-echelon roistering does too—then a department of seemingly intelligent, well-qualified engineers begins to mill about like a leaderless horse herd, confused, jittery, ready to stampede, out of touch with reality.

Somebody has to run the store. It may not have to be the engineering vice-president or the chief engineer—if the next man in line has the necessary authority and knowledge, and if the decisions he makes will not be reversed or resented later by his superiors. But that tends to make the top title an empty one. And it suggests that the title should be chief salesman rather than chief engineer.

Leaders of the Mallory-Sharon technical team *(l. to r.) Lee S. Busch, Technical Director; Frank H. Vandenburgh, President; Graham B. Brown, Vice President, Marketing; Dan E. Cribbs, General Manager, Wrought Products Division.*

Take a new look at this

SPECIAL METALS TEAM

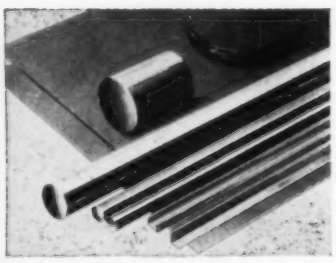
A whole new family of metals has come "of age" in the past decade. Titanium and zirconium already have progressed from expensive rarities to practical materials of construction. Other special metals will soon join them.

Looking for a fast-moving, on-its-toes "team" to assist you on special metals applications? Mallory-Sharon, largest integrated special metals producer, offers you just such a team. Within one organization, we control production from raw materials to finished mill products. Our entire experience and facilities, backed by a strong Service Engineering group, are devoted to special metals research and application.

To put this team to work for you, just write us about your needs or applications.

Research—*Microphotograph equipment for studying metallurgical grain structures. Mallory-Sharon is currently working on various government research projects, in addition to its own constant research and testing.*

Sponge Production—*Zirconium tetrachloride, delivered in these huge 6-ton rubber containers, is processed into zirconium sponge or platelets at Mallory-Sharon's modern sponge plant in Ashtabula, Ohio.*



Mill Products—*Both titanium and zirconium are available from Mallory-Sharon in sheet, strip, rod, bar, plate and other shapes. All are closely quality-controlled as to mechanical properties and chemical composition.*

MALLORY SHARON

MALLORY-SHARON METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

Axe Hovers Over Rival Weapons Projects

- **But design not necessarily the chief determinant—politics to be a big factor.**
- **Missiles, aircraft, communications, among projects to be affected by Administration decision to stay with $42 billion defense budget.**

WASHINGTON—The Defense Department is once more under the gun of an Administration economy drive, and Pentagon budget-cutters are training their sights on weapon-development projects with competing or rival objectives. These are the so-called "back-up" projects which have been run as extra insurance for vital programs, and other duplicating research and development efforts (see table), from which Pentagon budget planners hope to save several hundred million dollars.

According to a PRODUCT ENGINEERING survey, most costly R & D duplication exists in the advanced missile and aircraft fields, where each service has been pushing ahead with limited coordination by the Defense Department. And it is in these fields that weeding-out of projects will occur.

Some of the major decisions will be made over the next two months as work is completed on the fiscal 1960 defense budget. So most cutbacks may not be reflected until after next July 1 when new funds are required to continue current projects.

Some projects will be discontinued outright; the scope of others will be reduced. A major objective is to prevent competing research projects from moving too far into the advanced hardware stage.

Keep these key points in mind:

- Design and other technical considerations will not necessarily be the chief determinant in washing out duplicating R & D activity.
- In many instances—particularly when there's no clearcut evidence of technological superiority for one project over another—politics will play a big role. Congressmen will push projects of contractors in their districts.
- Military bureaucrats will pull strings to hold their own pet programs.
- Industrial contractors will engage in politicking to influence Defense Department decisions.

Here is a rundown of outstanding R & D projects where duplication of effort in involved.

THOR VS JUPITER IRBM'S.

Both are liquid-propellant missiles with similar missions and performance characteristics. Both use the 110,000-lb thrust rocket engine built by North American Aviation's Rocketdyne Div. Major differences in the missiles are in nose cone and guidance system designs. Thor has a liquid-floated gyroscope, while Jupiter's is air-floated. There's no conclusive evidence, apparently, that one is decisively superior to the other as far as costs, reliability, ease of maintenance, or other factors are concerned. The outlook is for continued volume production of Thor (by Douglas Aircraft, AC Sparkplug, and other contractors). More limited output of Jupiter (Chrysler Corp, Ford Instrument) will continue only until there's enough inventory to equip the two or three squadrons now planned.

A major consideration in the Thor-Jupiter rivalry is that the Air Force won out over the Army in the fight for control of the IRBM. Ever since, it's been a foregone conclusion that the Thor—Air Force's own development project—would eventually get the nod for heaviest volume production. The Jupiter has been hanging on in prototype production as a back-up project—mostly because of political pressures, but partially because of Defense Secy. McElroy's opinion that Thor hadn't been fully proved in tests. Both projects were kept alive so long that the Pentagon winds up with production capacity for the two missiles and has decided to set up two

Status Chart of US Missile Programs

	What They Are	How They Stand
ICBM ATLAS vs. TITAN	Atlas ballistic missile with range over 5,000 miles; liquid propelled; contractors — Convair, North American Aviation, GE, Burroughs, AMF. Titan has same specifications and capability. Contractors: Martin, Aerojet, AVCO, Arma Bosch, Sperry Rand, Bell Labs.	Atlas being pushed to get operational weapon as soon as possible with more test-proven components. More sophisticated Titan started two years later as back-up project; is more venturesome research program, will continue on more relaxed time schedule.
ANTI MISSILE-MISSILE NIKE-ZEUS vs. WIZARD	Army anti-missile-missile with range of 200 miles planned. Solid-propellant engine. Major contractors: Bell Labs, Douglas Aircraft. The Wizard is an Air Force anti-missile project with much longer range initially planned. Air Force contractors — RCA-Convair and Lockheed-Raytheon — now ordered out of missile development, are limited to component study for electronic subsystems.	Once more policy is to push through project that's gone furthest. More sophisticated system is running only for study purposes, not for crash development of a weapon system.
AIRCRAFT F8U-3 vs. F4H	Chance Vought all-weather F8U-3 fighter plane being flight tested. Has one-man crew, one engine. McDonnell F4H all-weather fighter plane being flight tested. With a 2-man crew, the plane has the same mission and performance characteristics of F8U-3, different configuration.	It's a toss-up as to which of the rival planes will be ordered into mass production to become the fleet's latest operational carrier-borne all-weather interceptor plane.

or three Jupiter operational units.

NIKE HERCULES VS BOMARC

The Army's Nike Hercules, a more advanced edition of the Nike Ajax, is a rocket-powered surface-to-air missile with a range of over 75 miles. The Air Force's Bomarc is launched by a small rocket, then propelled by sustaining ramjet engines. A range of over 200 miles in the initial model, will be doubled in more advanced versions. Both projects will be kept alive in quantity production, but unit output of each will be well under what each service wants.

No new anti-aircraft missiles beyond these will be started in view of Russian missile progress. But the US won't kill these programs over the next 5 years or so, while the Soviet bomber threat exists.

F8U-3 VS F4H

These are two new Navy all-weather interceptor planes—the first developed by Chance Vought, the other by McDonnell. The F8U-3 is powered by one Pratt & Whitney J75 jet engine producing 15,000 lb of thrust at Mach 2 speeds. F4H is powered by two GE J79-2 engines producing 10,000 lb thrust each.

A Pentagon aircraft official calls the competition between the two planes a "political hot potato," and feels it has been costly to allow both projects to progress so far into production, and says the decision "could go either way."

ATLAS VS TITAN ICBM'S

Each missile is capable of being guided by radio, radio-inertial, or all inertial guidance—with the last type stressed for Titan. Atlas is 1½-stage missile—a booster and sustaining engine igniting at the same time. Titan is a true 2-stage missile. Atlas is designed for above-ground or "soft" installations, Titan for both "soft" and "hard" (or under-ground) launching bases. Titan is designed for easier logistic support. Engines and guidance systems can be interchanged between the two.

Titan probably has a broader range—with a maximum of almost 7,000 miles. Atlas will continue as a crash project, will get into much heavier-volume production. Titan is likely to become operational in limited numbers, and will serve as a major launching rocket for advanced space vehicles.

NIKE ZEUS VS WIZARD

Army's Nike Zeus (Bell Labs and Douglas) is being pushed as an anti-missile missile system. The competitive Air Force Wizard, no longer considered a "weapon system" project as such, is being continued only as a component study program to be fed into the 200-mile Nike Zeus, or later, longer-range active ballistic missile defense systems.

In a field as new as anti-missile missiles, the Pentagon will be reluctant to push too hard its fight against competitive R & D. The argument is made that competitive research is needed to rush results.

For major programs, wash-out decisions will be made by Defense Secy McElroy and comptroller McNeil. Service secretaries will have the final say on less costly projects. Decisions will be made on the basis of technical projects by a variety of sources.

The weapons systems evaluation groups, an inter-service agency under the control of Asst Secy of Defense for Research & Engineering, has general authority in this field, assisted by several universities on contract to the Pentagon. Paul D. Foote, the current assistant secretary, is resigning this month, and will be replaced by a new director of Defense Research & Engineering—a position authorized by the recent defense reorganization act. The Director, still unnamed as PRODUCT ENGINEERING went to press, will have stronger powers than the present assistant secretary.

In the missile field, Wm. M. Holaday, the Pentagon's Director of Guided Missiles, will have considerable influence on the upcoming decisions.

In the space field, Roy W. Johnson, director of the Pentagon's Advanced Research Projects Agency, will wield great influence.

Theoretically, these officials have had authority all along to weed out duplicating R & D operations. Their recommendations, however, have frequently been offset by political considerations. Most notable case: the continuation of the Army's Jupiter IRBM project after production of the rival Air Force Thor IRBM had begun. New stress on budget economies will strengthen hand of such officials.

Presumably, both Holaday's office and ARPA will be put under the administration of the incoming director of defense research and engineering.

The emphasis of reducing duplication of R & D effort will be tempered by the opinion of many top-level scientific advisors to the Defense Department. That competition—even duplication—of research effort is not necessarily bad. They contend that competitive research breeds more rapid and imaginative results.

The Pentagon's problem now is to weigh such considerations against fiscal realities. For the study and initial design stages of R & D projects, duplicating effort will still be tolerated—even encouraged. But for the later development stages, where expenditures become far more considerable, the new policy will be pushed hard.

How to Organize for Technical Development

NEW YORK—"There are five important guideposts that a company must follow if it is going to organize effectively for technical development," said Gen. James M. Gavin, vice-pres of Arthur D. Little, Inc., at the Special R & D Conference of the American Management Association held here. "These guideposts are:

"1. Know the state of the art or science of the field in which you hope to embark. If a mistake is made here, it can be a critical decision for a company. As an example, the Army could have started work on a boron engine five years ago and poured millions into the project, but the science in that field wasn't ready for it.

"2. Know the market for the product; there has to be one. If it is a case of getting ideas, listen to your research chiefs for a while and they will give you more ideas than you know what to do with.

"3. Know the corporate resources—facilities as well as money.

"4. Put the project in charge of one man. He undoubtedly will come from the group that did the initial study work.

"5. Start your line of direction on a broad basis and narrow it down as fast as you can. Do not take the attitude that you can expect to go from one point to another in a certain period of time."

GM Predicts Aluminum Engines, Lighter Cars

- **Costs will soon be competitive with gray iron.**
- **Aluminum potential in cars is 157 lb—which would replace 600 lb of cast iron.**
- **Gray iron manufacturers must develop new products to replace business they are sure to lose.**

WASHINGTON—Aluminum engines are now competitive with iron from a cost standpoint. This is the consensus in papers presented here at the annual meeting of the Gray Iron Founders Society.

An aluminum engine can weigh up to 200 lb less than its cast iron counterpart, said Darl F. Caris, engineering staff, General Motors Corp., and this is only the beginning. The lighter engine requires less structure to support it, lighter tires, lighter brakes, and it permits better weight distribution. The result: an appreciably lighter automobile to counteract the current trend to heavier cars and lower fuel economy (see table and *PE—Sept 8, p 19*).

Location of the foundry adjacent to aluminum reduction plants permits pouring metal directly from the reduction cells (one such installation is already operating at Jones Mills, Arkansas, and a second will be starting up shortly at Messena, NY). This, together with improved foundry techniques and savings in machining, has made aluminum highly competitive with cast iron.

In another paper, Dr. Robert F. Thomson of the research staff of General Motors Corp. said, "Wear-resistant aluminum alloys, including high silicon materials, have shown satisfactory wear characteristics both in dynamometer and field tests with experimental V-8 engines." He reported GM Reseach Laboratory's Metallurgical Engineering Dept. had investigated various cylinder-bore coatings. With diesel cylinder iron set at 100%, cast iron wear under similar conditions was 200%; aluminum, 25-50%; sprayed molybdenum approximately 15% and chromium plate approximately 10% (though chromium plate spalls at the point of piston reversal). Other metals tested were iron plate, nickel plate, oxide-type coatings, sprayed steel, sprayed aluminum and its alloys. These have shown varying degrees of promise from very good to satisfactory. If "none of these finally meet all requirements," said Dr. Thomson, "we can always rely on a cast iron (cylinder) liner, although this is not the ideal solution and will not achieve the goal of maximum weight reduction at minimum cost. We do not believe cast iron as a bore material will finally be necessary."

Discussing production problems, Dr. Thomson explained that metallurgists have some latitude in molding methods such as die casting, permanent-mold equipment or semi-permanent-mold methods. Pointing out that aluminum engines present no impossible machining problems, Dr. Thomson added, "There has been considerable loose talk to the effect that machining rates may be much higher than presently used for cast iron. This may or may not be true, depending upon which alloys are subsequently specified. The very high silicon alloys, for example, have about 50% greater tool wear rates than conventional aluminum alloys, whereas conventional alloys can probably be machined faster than gray iron." Although aluminum castings are considerably more expensive per pound than iron castings the greatly reduced weight of the aluminum engine offsets this disadvantage (see table).

Commenting on the impact aluminum engines may have on the iron foundry business, Dr. Thomson pointed out that the average amount of aluminum per car since pre-World War II days (1938) has risen from 2lb to an estimated 57 lb in 1959, but the gray iron casting business has not felt this too much because of increasing car weights. But in the future car weights are expected to go down. "This will have two effects. The actual number of pounds of ferrous product (will be reduced) as car weight goes down but, more imperatively, there will be an increased emphasis on reducing car weight without corresponding decrease in roominess and performance. So more and more engineers will be trying to replace ferrous materials with light metals." Admitting that gray iron is a good cheap material, Dr. Thomson urged the industry to 1) improve its product to meet competitive materials, 2) make its outlook flexible so that if improvement is insufficient to meet the challenge of lighter metals it can produce the competitive materials on an economic basis, 3) develop new products to replace business which must inevitably be lost.

Later in this meeting E. J. Tangerman, editor of Product Engineering and chairman of the Judging Committee, presented awards to the 1958 Gray Iron Founders Society Design Contest winners.

Trends in car weight and economy

Year	Curb weight lb	Highway fuel economy
1946	3820	15½ mi/gal
1948	3860	16
1950	3830	16½
1952	3900	18
1954	4050	19
1956	4150	*18
1958	4400	*17¼

*In these years the automatic gear shift and other accessories reduced highway fuel economy.

Cast iron vs aluminum die casting

	Cast iron	Aluminum die casting
Casting weight	235 lb	49 lb
Finished weight	195 lb	43 lb
Estimated cost/lb ...	$ .10	$ .45
Finished cost	$19.50	$19.30

Note: Die casting permits the use of thinner walls therefore the ratio of finished weights is greater than the comparable ratio of densities. At the present time aluminum cylinder blocks would require cylinder sleeves whose cost would add to the finished cost listed above.

K+E

develops unique drafting surface on Du Pont Mylar® base for HERCULENE TRADEMARK Drafting Film

Why unique?

Only K&E has the skill and 90 years' experience that produced America's most preferred tracing paper and tracing cloth. Now K&E is producing, on a Du Pont "Mylar" film base, another superb drafting medium.

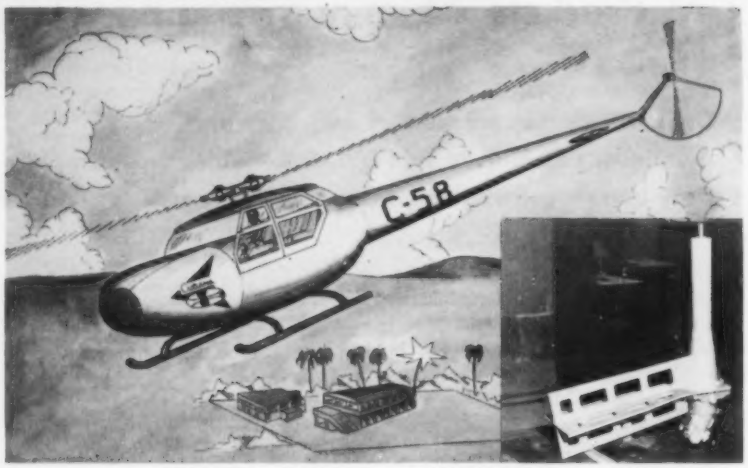
Herculene Drafting Film is superb four ways:

- superb for pencil drafting
- superb for ink work
- superb for typewriting
- and for all three – it has unequalled erasing qualities.

Convince *yourself*. We'll gladly send you a free sample of Herculene Drafting Film. Just fill in and mail the coupon.

K+E

KEUFFEL & ESSER CO.
Dept. PE-10 Hoboken, N. J.
Please send me details and a test sheet of K&E Herculene Drafting Film.
Name_____
Company_____
Address_____



Tail of a rotor . . .
Cubana de Aviacion is building a new helicopter, artist's conception above, based on Republic Aviation's Alouette, but tail rotor is variable-speed rather than variable-pitch. Inset at right shows the tail rotor with its Vickers hydraulic motor, and the shaft extension that carries the rotor.

New Copter Tail Rotor Has Variable Speed

HAVANA—A helicopter tail rotor with fixed pitch and variable speed (750 to 1800 rpm) has been designed here by Compania de Aviacion, SA, Cuba's largest airline, for its C-58 helicopter. Most of the C-58 design is based on Republic Aircraft's Alouette copter.

According to the designer, Juan de la Cierva y Hoces, the rotor is hydraulically operated. The variable displacement pump for the hydraulic system is located behind the engine gear box. The hydraulic system is variable-pressure and variable-flow, is critically damped by an accumulator. Peak pressure is 3000 psi, time constant is 1.7 sec. Pedals directly control pump displacement.

The C-58 copter, which Cuba hopes will beef up its aircraft industry, will be 45 ft long, weigh 3000 lb at take-off, reach 10,000 ft max altitude, be powered by a 260-hp engine, have max speed of 120 mph, have a 375-mile range, and be capable of flying 4 hr without refueling.

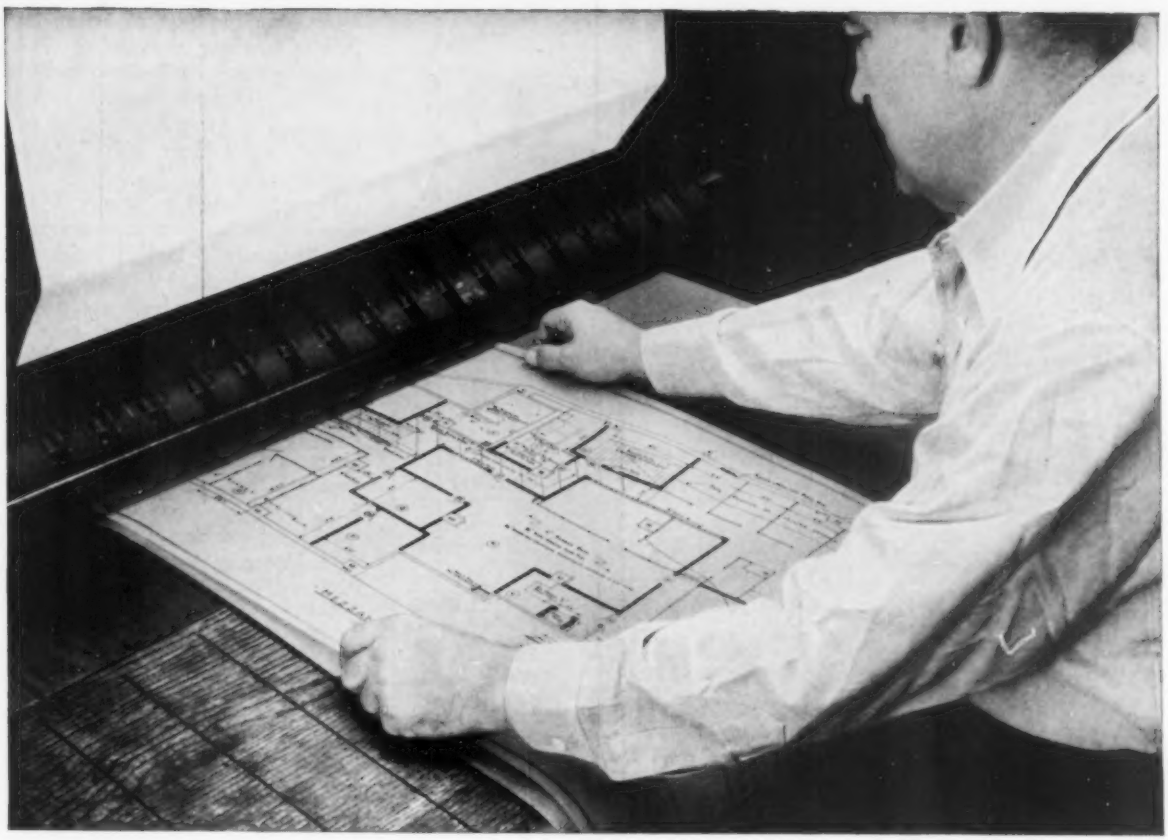
Peiping Show Warns the West

Peter Trippe, London correspondent, translates and interprets reports of a Communist Chinese equipment show. Here is evidence that China is out to show that she can beat the Soviet Union and possibly the West—in production within a few years. Her machine-tool output is claimed to be 80,000 units this year, trebling that of 1957. This industry is estimated to be growing at the rate of 60% a year. Comments have been added by the Editor, based on information from his USSR trip.

PEIPING—Nine years ago Chinese industry was about as backward as any in the world. This year her engineers are displaying industrial equipment that ranks among the world's best.

Rapid transition from primitive to sophisticated industrial techniques was spotlighted at last month's industrial exhibition here. In a 15-pavillion show visitors saw technically advanced tools displayed by Chinese industrialists who have already become independent of Soviet technical assistance. The exhibit suggested further that the Chinese are organizing their industry so it will be peculiarly adapted to the country's social and cultural conditions. This calls for emphasis on automation to make best use of a large but unskilled labor force.

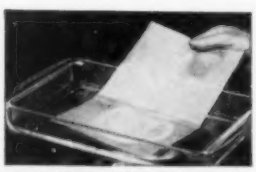
Tools on exhibit came in a wide range of sizes and possessed a high degree of precision. The machine-tool section included a precision-gear grinder from a Shanghai plant that is said to finish work to 3 microns. On display also was a planer with a 7-ft



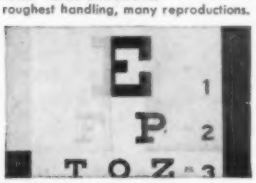
NOW AVAILABLE!

New drafting films made with Du Pont Mylar® resist cracking... safeguard your investment

HIGH TEAR STRENGTH ... withstands roughest handling, many reproductions.



OUTSTANDING STABILITY... won't dry out or shrink ... remains waterproof.



SUPERIOR TRANSLUCENCY ... faster, more accurate printing ... fiber-free.

GREATER FLEXIBILITY ... rolls up repeatedly without cracking ... lies flat.

Now you can safeguard your investment in costly original drawings by using the new pencil and ink drafting films made with Du Pont "Mylar"* polyester film. What's more, these crack-resistant drafting films *cost no more* than many grades of cloth!

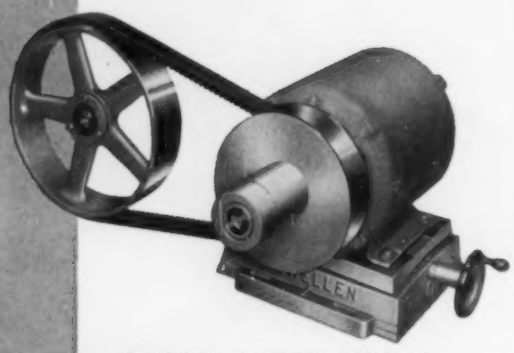
Look at the remarkable combination of benefits found in these new drafting films! They resist tearing ... won't embrittle with heat used in reproduction ... won't yellow with age ... won't soak up moisture or grease from hands ... remain waterproof. Next time you order, specify drafting film made with "Mylar".

*"Mylar" is a registered trademark for Du Pont's brand of polyester film. Du Pont makes the base material "Mylar"—most leading manufacturers of drafting materials are now offering pencil and ink drafting films made with Du Pont "Mylar".

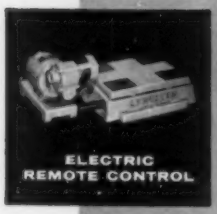
SEND FOR FREE SAMPLES. See for yourself the many performance advantages you get with new drafting films made with "Mylar" polyester film. Send for your sample sheets today! Write E. I. du Pont de Nemours & Co. (Inc.), Film Dept., Room P-10, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM



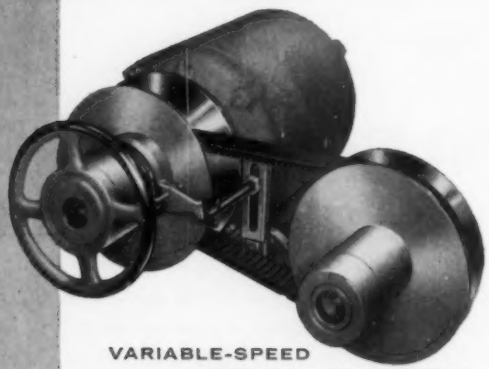
VARIABLE-SPEED PULLEY
Ratings to 15 H.P. Speed Ranges to 4:1



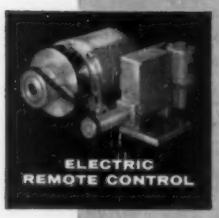
NEW 400 SERIES—VARIABLE SPEED PULLEYS

LEWELLEN

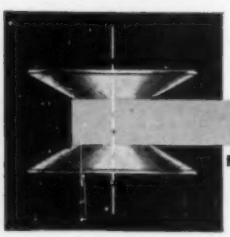
that elusive best speed conveniently available



VARIABLE-SPEED
COMBINATION PULLEYS
Ratings to 25 H.P. Speed Ranges to 10:1



Here are design changes that greatly enhance the flexibility, usefulness and convenience of Variable Pulley Drives. Wherever the drive locates, there is a choice of speed regulating devices that provide precisely adjustable ratios over wide speed ranges. *Check and compare the new Lewellen 400 Series!*



LEWELLEN
Manufacturing Company, Columbus, Indiana
Distributors in All Industrial Areas. In Canada—
Peerless Engineering Sales, Ltd., Toronto-Montreal

wide table and vertical boring mill with a working capacity of 7½-ft. Larger models, now believed to be in final stages of production, will include a planer that has a 3-meter table and has a vertical borer with 3.4-meter capacity.

For manufacturing instruments, the Chinese are building machines with spindle speeds up to 12,000 rpm and instrument drills that are down to 0.1-min dia. In use too is a saw blade that measures 30-ft dia; grinding wheels that range from 0.1 mm thick; grinders with surface speeds that run up to 16,000 fpm; carbide cutting tools up to 0.5-meter dia; and cutters for producing gears up to 20 module. Broaches that can give a grade 10 finish are said to come in two designs.

China is making use of her vast natural resources to produce a range of steels and non-ferrous metals. Cold-rolled strip 0.001 in. thick was shown as well as a Bessemer converter that had been developed locally. Precision casting is being used for mass-producing cutters, and some success is being achieved with brazing tool-steel cutters to mild-steel shanks, then twisting them to obtain the helix. This technique was obviously learned from Russia. I saw a set-up using the method during my visit 18 months ago.

The use of ball bearings is being increasingly emphasized and China claims she can mass-produce precision bearings that operate up to 100,000 rpm. (This is an interesting statement. The Russians are devising air bearings because of difficulties with precision ball bearings at speeds of only 50,000 rpm. *PE—July* 14, p 16, '58—Ed). Planning committee goals prescribe use of standard ball bearings on all vehicles, tools and instruments whenever possible. Such emphasis may put China in a position exceeded only by that of the USSR.

EMPHASIZE AUTOMATION

Automation is basic to design of Chinese equipment. China has an enormous population — 640,000,000 million—and the number of people is increasing rapidly. But only a sprinkling of these people are trained technologists or skilled workers and the problem of finding teachers is difficult. Hence, there is emphasis on designing skill into the machine instead of the operator. (Automation saves labor but requires added skilled workers for maintenance and supervision, judging

by present American experience.—Ed.)

The Chinese are familiar with modern multiple-tooling techniques. On exhibit was a 24-spindle machine that mounts 40 cutters. A duplex-type horizontal machine, it had hydraulic-electronic controls and was said to have eight times the productivity of its predecessor. In literal translation from the Chinese, these machines are called "aggregate" machines.

Copy turning with both hydraulic and electric systems is in widespread use. The Chinese say they have hydraulic copying equipment that works to a precision of better than 0.001 in. They add—rightly or wrongly—that this equipment is superior to its Western counterparts. (This again is an interesting statement in the light of limited use of hydraulics evident in Soviet machine tools.—Ed.

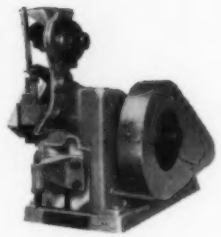
ENCOURAGE LOCAL INDUSTRY

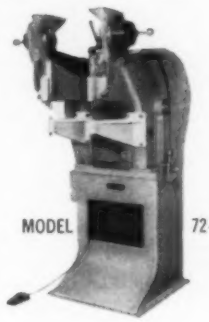
There is a basic difference between the Chinese and Russian five-year plans. China's proletariat is based on the peasant; Russia's on the industrial worker. This shows in various ways:

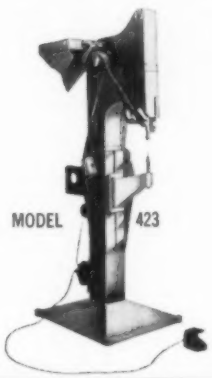
At the exhibit the Chinese showed along with advanced designs some simple heavy-duty tools specifically designed for local industries in rural areas. These tools require little skill and almost no maintenance. The peasants themselves are improvising. I have seen examples of rudimentary fork-lift and conveying systems designed by the agricultural peasentry. The whole of China—not simply the technologically elite—are becoming "automation-conscious".

Further, the Chinese have announced their intention of boosting local industry. This is in sharp contrast to Soviet practice of rigorous planning by a central committee whose decisions go through regional committees to avoid duplication.

The industrial exhibit suggests that the Chinese industrial upsurge is a domestic phenomenon that is almost fully weaned from dependence on Soviet engineers and advisors. China, however, considers herself in no way subservient to her teacher—the USSR. A director of a large Chinese power plant, summed up the attitude when he said: "In 1954 I saw the big machines displayed here in the exhibition of the achievements of the Soviet Union. I never though that a few years later my own country would be turning out similar heavy equipment."


MODEL 52



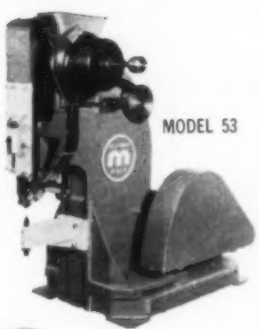


CUT ASSEMBLY COSTS...

with Milford's complete riveter line

Bench or Pedestal Models
Single or Multiple Spindle
Automatic or Manual Operation

Milford Rivet-Setting Machines can be adapted to solve nearly every fastening and assembly problem. Count on Milford's versatility and ability to come up with the right answers at substantial cost savings. To take full advantage of automatic assembly—get in touch with Milford first!


MODEL 53

MODEL 250

THE MILFORD RIVET

MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.

(Advertisement)

MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

CONTACT ANGLE

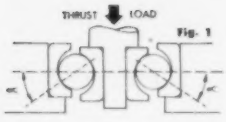


Fig. 1

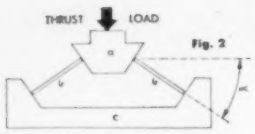


Fig. 2

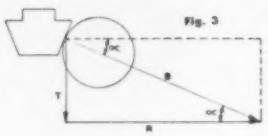


Fig. 3

Contact angle is the angle between a plane perpendicular to the bearing axis and a line connecting the two points on a given ball where the ball makes contact with the raceways when the bearing is subjected to a pure thrust load. In *Fig. 1*, the contact angle is represented by angle α. The significance of the contact angle is revealed by an examination of the forces present in a thrust loaded bearing.

In *Fig. 2*, a simplified version of *Fig. 1*, the shaft and inner ring combination are represented by the plug *a*, the "working diameters" of the balls and represented by the rodlike members at *b*, and the outer ring is represented by the tapered cup *c*.

The contact angle is α. This diagram represents a three-dimensional structure with as many equally spaced rods, *b*, as there are balls in the bearing.

The primary concern in design is the amount of compressive force to which rod *b* is subject, which is the force with which a given ball is pressed against the raceways. This force can be calculated by constructing a parallelogram of forces as shown in *Fig. 3*.

The sides T and R, are vector quantities, and diagonal B is the vector sum of T and R. Furthermore, the vector sum of the thrust components on all the balls equals the total thrust load on the bearing. The vector sum of the radial components on all the balls is zero. Vector B, the force actually felt by the raceways and balls, compared to vector T, the thrust component, varies significantly with changes in the size of the contact angle and is directly proportional to the thrust load component and inversely proportional to the sine of the contact angle.

Example I:

A bearing is carrying a pure thrust load of 21 pounds. Assuming seven balls in the bearing, each ball will have an axial load component of three pounds, since a thrust load is shared equally by all the balls. While the axial component on each ball is only three pounds, the actual compressive force, or squeeze, felt by the ball and raceways is considerably greater than this value.

With a contact angle of five degrees:

$$B = \frac{T}{\sin \alpha} = \frac{3 \text{ lbs.}}{\sin 5^\circ} = 34.5 \text{ lbs.}$$

Thus we see that with a five-degree contact angle the actual load felt by each individual ball is actually considerably greater than the total 21 pound thrust load on the bearing.

Example II:

Using the thrust conditions in Example 1, the contact angle is increased to 20 degrees, by selecting a bearing with a larger value of radial play.

$$B = \frac{3 \text{ pounds}}{\sin 20^\circ} = 8.78 \text{ pounds}$$

A 15 degree increase in contact angle produced a 74.5% reduction in ball-to-raceway contact stress. This relationship should be noted by anyone who writes bearing specifications. The operational qualities of the bearing, such as low running and starting torque and bearing life, are a function of the ball-to-raceway contact stress. Thus the contact angle is highly significant.

It is not necessary for a bearing user to calculate or specify the contact angle desired. It is only necessary to remember that low values of contact angle are associated with low radial play, and high values of contact angle are associated with high radial play. In addition to the above considerations, gyratory forces become extremely important factors in determining optimum contact angle in high speed applications.

A more complete discussion of contact angle is found in our design handbook.

DESIGNERS HANDBOOK OFFERED *FREE* TO ENGINEERS

If you work with miniature bearings, you'll find this new, 70-page authoritative publication a great help in solving problems in designing instruments or small electro-mechanical assemblies.

It will be sent free to engineers, draftsmen and purchasing agents. **Write to: New Hampshire Ball Bearings, Inc., Peterborough 1, N.H.**

NEW HAMPSHIRE BALL BEARINGS, INC., PETERBOROUGH 1, NEW HAMPSHIRE
***District Offices:* Pasadena, Calif.; Park Ridge, Ill.; and Great Neck, N. Y.**

British Computer Has 30 Million Character Storage

LONDON—A new high-speed British computer equipped with 3 storage forms—magnetic tape, ferrite core and diode capacity registers—that can store 30 million alphanumeric characters is being developed by EMI Electronics, Ltd, under sponsorship of British National Research and Development Corp.

In the magnetic storage, a 4-in. wide tape (without fast stop-start capabilities) provides low-cost bulk storage with 9 tracks on each of 10 channels. For fast access, a 1-in tape with a 5-millisec stop-start time will store on its 6 tracks some 6 million characters on each 2-ft reel.

The EMID 2400 has 4 main units—input, search, computing, and printout. Input unit can be equipped with up to 112 keyboard inputs which can take the form of direct keyboard instruments, paper tape, punched card or line-transmitted data. A buffer storage of 4096 x 14 bits is included in the input circuits.

Search unit which can automatically switch to any one of a number of files selects a record or any section of a record from the 4-in. tape file. A 1-in. tape input to the unit gives an ordered list of record numbers and parts of the record to be selected. The output is a further 1-in. tape containing selected data and notifications of any errors during selection process.

Use of 2-phase 1-microsec clock and flip-flop circuits to time-synchronous operations in the computing unit cut counting to 0.5 microsec. Multiplication and division takes 50 to 60 microsec.

The computer unit has two stores—a 4096 magnetic core store and 64 diode capacity working registers with a read-rewrite time of 3 microsec.

Take Technical Census

LONDON—Survey of R & D reveals that 130,000 Britons are engaged in R & D work and, of these, 30,000 hold a degree or equivalent qualifications in science or engineering. England's manufacturing industries employs 33% of all qualified scientists; 54% of all engineers.

As machined by a numerically controlled milling machine.

Numerical Control and the Design Engineer

The design engineer's role in numerical control is critical. Here's how his attitude and methods will affect and be affected by new techniques in automatic manufacturing.

H. J. LANGLIE

Project Engineer, ALWAC Computer Division, El-Tronics, Inc., Hawthorne, Calif.

This is the first of two articles covering the role of numerical control and its influence on the designer. Next week the Design issue will carry a further discussion of how numerically controlled machines actually operate with a step by step example.

■ If numerical control has been hailed as the liberator of the production line—and with some basis in truth—it promises to do as much or more to liberate the design engineer from his drafting board. Furthermore, this change in design techniques could have a far more profound effect on the state of the art of automatic manufacturing than any single technical advancement made since the end of World War II.

For years the designer has been forced to represent 3-dimensional hardware by drawing pictures on 2-dimensional paper. He has had to use this same antiquated language to describe the increasingly complicated shapes of present-day design—a situation rapidly reaching a saturation point. This is the problem to which advanced engineering can bring its own answer—numerical-control design. Today the designer can give his instructions directly to the production machine in a language which is more natural to both machine and engineer than orthographic projection ever hoped to be.

Numerical control uses numbers to control the movement of a machine tool. A series of numbers punched on paper tape or on cards refers to a series of consecutive tool positions. "Discrete positioning" describes a method of locating a tool over a number of positions as, for example, when drilling holes in a large spar. From this method evolved a more elegant process known as "continuous path control" which involves drawing the cutting tool through curves in space and thereby cutting smooth contours in the workpiece. Communication between designer and machine assembly is essentially the same for either form of numerical control; it is quantitative rather than descriptive.

Numerical control introduced new problems: In what manner is the information passed from designer to machine? What stages of processing are necessary to convert the quantitative information into machine-tool cutting action?

The evolution of numerical control has brought about a generalized three-part system:

(1) A data-processing system translates the information from designer and tool planner into language for a computer which then converts this information into a long sequence of digits.

(2) This sequence is translated, by a device called an *interpolator*, into an electronic code consisting of pulses or wave forms.

(3) The wave forms are received by servomechanisms on the machine tool which interpret the signals as motion.

These information-conversion steps have

A numerical-control tool system.

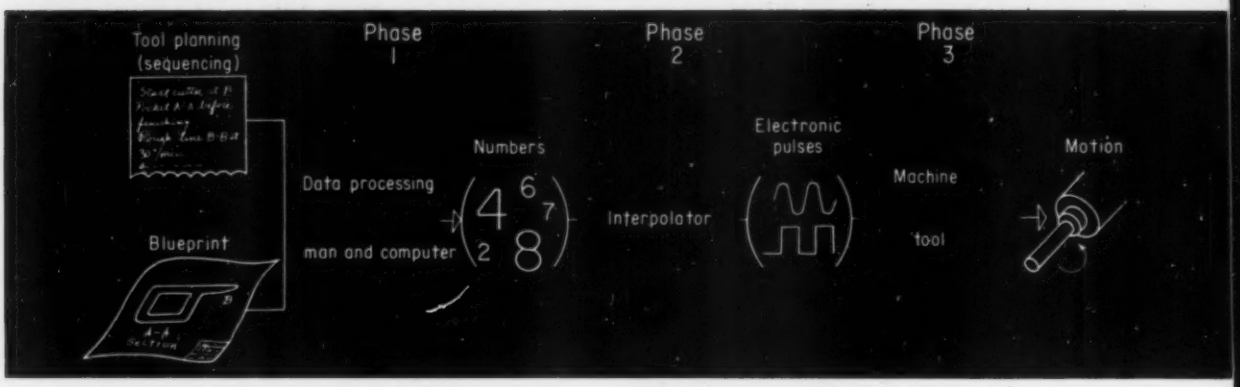


TABLE 1 — NUMERICAL CONTROL VS CONVENTIONAL MACHINING — THE THREE STAGES

STAGE	OPERATION	METHODS	
		Conventional	Numerical Control
1	Receipt of part description (input data)	Blueprint	?
2	Process of converting input data to working data	Loft lines, templets, patterns, plaster, wood forms, jigs, holding fixtures, tool planning	Man and computer; tool planning; punched paper tape; holding fixtures
3	Application of working data to workpiece	Manual Kellering; manual or semi-automatic templet tracing; extensive hand finishing	Punched paper tape to interpolater and machine-tool combination; minimum (if any) hand finishing

their parallel in conventional operation processes, as shown in Table I. The most outstanding savings in time and money over conventional methods are realized in stage 2 where all of the preprocessing materials (templets, patterns, etc.) are replaced by a roll of punched tape. Further advantages in terms of unprecedented quality control and ease of duplicating parts are realized in the production stage. In one instance, an aircraft manufacturer reduced the weight of his communicating media from over 2000 lb in conventional operation to 10 oz for numerical control which included a thin sheaf of papers and a roll of punched tape small enough to hold in the palm of the hand.

The designer is most concerned with stage 1—the form of input data. Current practice is still dependent on the conventional blueprint for two reasons—it's the accepted thing to do, and nobody has offered anything better.

Any new, direct form of input data will depend to some extent on the data-processing system involved. But no matter what specific form of input is used, the design engineer will find that the precise, numerical part descriptions for numerical control are a far more logical extension of the engineering process than are 3-dimensional pictures drawn on 2-dimensional paper.

A large part of design is based on analytical data. A cam shape is determined by elements of mechanical efficiency. A shield is fitted to a protruding part by creating curved lines with restrictions governing slopes at top and bottom, rate of curvature, and other logical (and therefore mathematically expressible) considerations. In many instances a designer will work from an equation, patiently plot the points of the curve, and then fair in the line with a French curve. In so doing the analytical information is exchanged for visual information. It is paradoxical that the numerical-control part programmer has to undo all of this effort by selecting points from the visual presentation and, by means of curve fitting, transform the visual information back into analytical information which a computer understands.

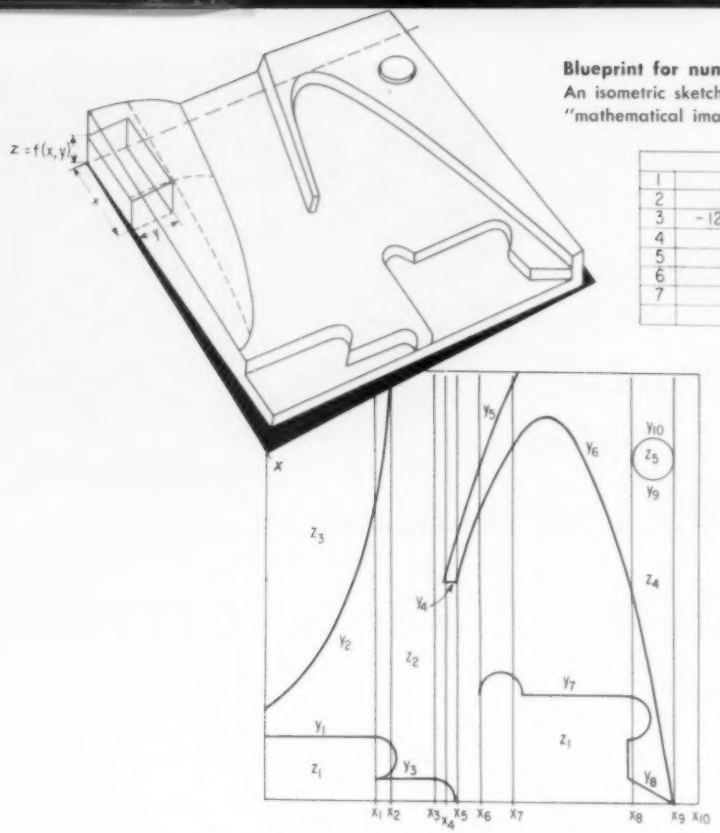
Ironically, the cost of information transference is usually even further increased by the efforts of the conscientious part programmer to read more into the visual presentation than was intended by the designer. This duplication of effort is eliminated when the designer works with data in a form more suitable for numerical control.

A numerical-control data-processing program has been developed, for use with the ALWAC III-E magnetic drum computer, which involves two information inputs,

- part description (in mathematical language), and
- cutting sequence (tool planning).

Part description is the responsibility of the design engineer. Tool planning is a manufacturing process and, as such, is supplied by the part programmer who is the numerical control counterpart of the tool planner.

In this program, the part description is given to the computer as a series of equations of the regions of the workpiece and of the profiles or boundaries which



Blueprint for numerical control gives formulas for each zone. An isometric sketch helps operator visualize the computer's "mathematical image" of the part.

z - BANDS	
1	0.5"
2	1.0"
3	$-12\frac{1}{2}x^2+\frac{5}{8}(1-y^2)+2y$
4	1.5
5	1.6
6	
7	

x - BANDS	
1	2.5"
2	2.828
3	4.0
4	4.25
5	4.5
6	5.0
7	5.75
8	8.5
9	9.5
10	10.0
11	*
12	

y - BANDS		
1	1.5"	$(0<x<x_1)$
2	$2.0+x^2$	$(0<x<x_2)$
3	0.5	$(x_1<x<x_3)$
4	5.0	$(x_4<x<x_5)$
5	$3\frac{1}{3}-9\frac{1}{6}x$	$(x_4<x<x_7)$
6	$13x-x^2-33\frac{1}{4}$	$(x_5<x<x_9)$
7	2.5	$(x_6<x<x_8)$
8	$4\frac{3}{4}-\frac{1}{2}x$	$(x_8<x<x_9)$
9	See Notes	
10		
11		
12		

Notes:

$y_9 = -(Ax+B)-\sqrt{\ }$

$y_{10} = -(Ax+B)+\sqrt{\ }$

where

$\sqrt{\ } = \sqrt{(Ax+B)^2+P_2(x)}$

and

$A = 0$

$B = -8.0$

$a_0 = -72.375$

$a_1 = 9.0$

$a_2 = -0.5$

all for $(x_6<x<x_9)$

separate one type of region from another. The organization of these equations for insertion into the computer is a simple, straightforward process, but the derivation of the equations from a conventional blueprint is not always so easy. This is because it is impossible to derive an equation which exactly represents an arbitrarily drawn curve for every point on the curve—curve fitting is partly subjective. Happily, with numerical control, the designer can present an effective, unique 3-dimensional description which leaves no room for misinterpretation. He does this by passing on to the manufacturing department the equations which represent the abstract thoughts he normally uses to guide him in drawing his picture. With this information, the part programmer's problem of deciphering a blueprint is eliminated.

The numerical-control blueprint is a precise definition of the locations (mathematically, the "locus") of all the points of the surfaces of the workpiece. In all probability, the definition would be accompanied by a top view (or perspective) sketch of the finished configuration as a visual aid. In this instance the picture is no longer the end result, but merely a means to an end. The numerical-control blueprint has several salient features:

- It is precise. It is not subject to misinterpretation.
- It is basically an easier instrument to prepare.
- It can be interpreted readily by personnel engaged in numerical-control data processing.
- It is less bulky than conventional blueprints because the scale geometry does not have to be preserved.

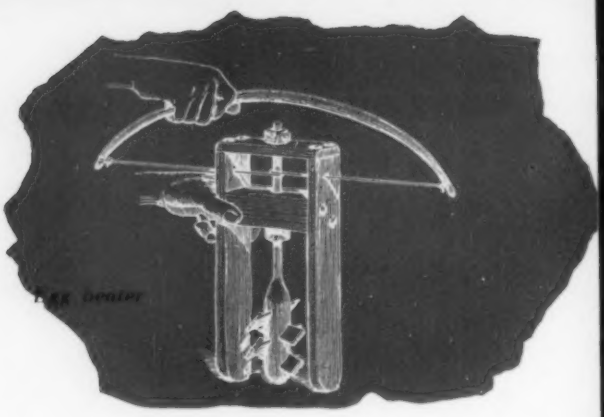
The numerical-control blueprint then becomes the input form, provided by the designer, for stage 1 in Table I. It might look like the example above. The computer makes a mathematical "image" of the workpiece on a point-by-point basis. With this image established in the computer, the cutting tool is programmed over the workpiece in the sequence established by the part programmer in the tool planning stage. The computer output, on cards or on tape, is then read into the machine tool and the part is milled from metal.

The numerical-control designer will find himself learning some new tricks and discarding some old ones.

- He will become less of an artist and more of an engineer.
- He will have more occasion to use the elements of his college algebra and analytic geometry in preparing descriptions for numerical control.
- He will ultimately become more closely allied with the analytical engineer on one hand and the manufacturing part-programmer on the other.

It is significant that numerical control, in its infancy, is on the threshold of bringing about a metamorphosis in the metalworking industry. There has always been a desire to create a common language for the use of industry in all of its vast and separate enterprises. Numerical control is taking this step by creating a stronger bond between analytical engineering, analytical design, and analytical manufacturing. ■

Door latch

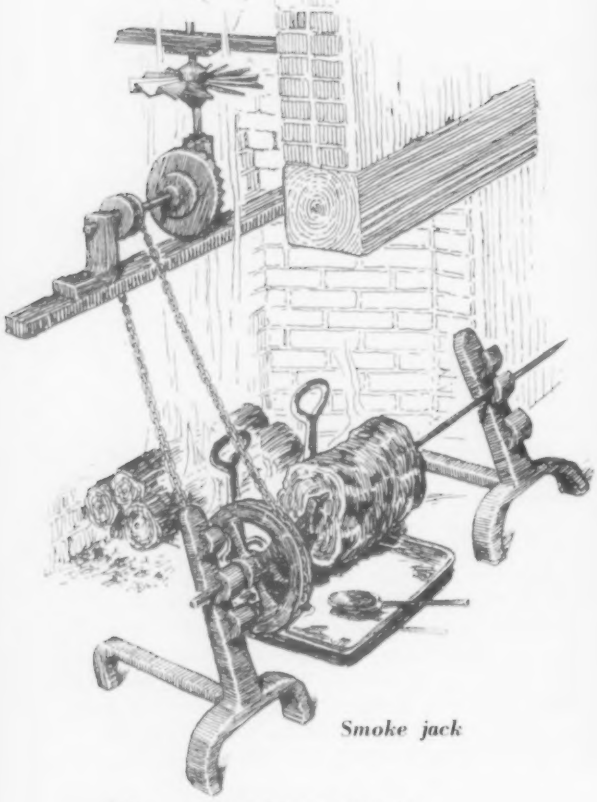


TRENDS in appearance design...

DESIGNING

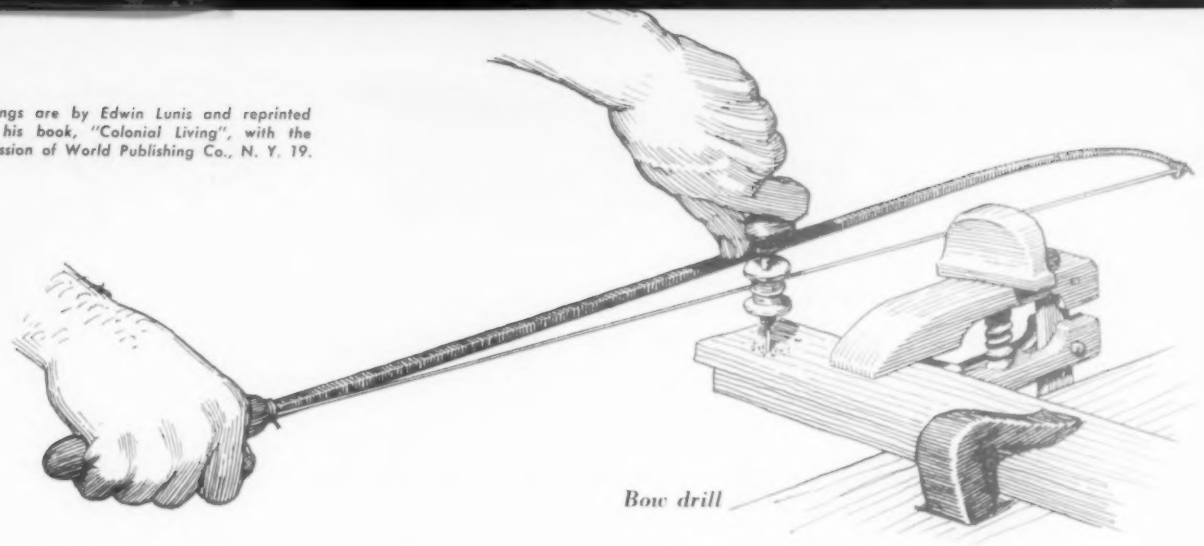
Door hinge

Spring-pole lathe



Smoke jack

Drawings are by Edwin Lunis and reprinted from his book, "Colonial Living", with the permission of World Publishing Co., N. Y. 19.



Bow drill

A PRODUCT—THEN AND NOW

RAYMOND SPILMAN, Industrial Designer, and John Kolb, Associate Editor

Even the quickest glance at products typical of our early years as a nation reveals the working, living, day-to-day contact that once existed between user and designer-producer. Buyers of 18th century farming and household implements, tools and primitive manufacturing, often lived near the artisans' workshops, or in the surrounding countryside. Over many generations, these customers directly and personally influenced the designer-producer. This close relationship originated in the European guild system. It had, as its over-riding concern, the most productive, least tiring use of the weakest source of energy of all, muscle-power.

Even if such intimate and frequent contact with the consumer were possible in modern America, it would probably not be as productive of good and useful design. This tendency toward mutual isolation is a problem shared by designer and consumer alike, and arises from mass production itself. The designs of a numerically small product-planning and engineering group are used by a much larger working force to produce for markets made up of millions—even tens of millions—of consumers. The answer probably lies at least partly in forms of coordination not yet devised.

And then there is the fact that man's basis for getting things done has changed. Today, the designer frequently spends a major part of his time devising forms and controls for manipulating vast amounts of various types of energy, often in products wherein expenditure of muscle-power has almost entirely given way to such activities as observation, adjustment and being transported.

Our own country is the largest consumer of the major sources of energy. We employ more designers and produce more manufactured consumer goods than any other country. Yet these products are seldom as disciplined by intended end-use or as characteristically American as the 18th century products illustrated on these pages. Rather, they represent a certain point of development of our comparatively immature country.

Take, for example, our largest manufacturing industry, automobiles. The majority of the stylists are between 20 and 30 years old, and for the most part, tend to produce professionally immature designs. This limitation is further complicated by the fact that final decisions on actual appearance are made by sectors of management without formal design training. Their authority to select design is predicated on their accomplishments in sales and other such activities.

This is to be expected in a country where, since we came of age as an industrial nation, conception, development and production of manufactured goods has been based largely on the standards of obsolescense in the marketplace, rather than those of function and use.

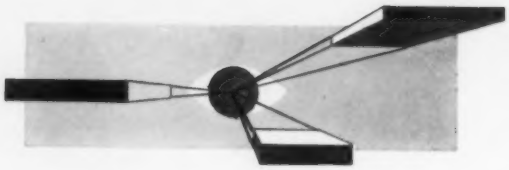
Obviously, this could not have occurred without affecting those who buy and use the products. Surveys and market research repeatedly indicate a growing market for less chrome on automobiles, less bric-a-brac around the house, less gingerbread in the design of furniture, yet the fact remains that John Q. Public usually buys over-designed products, out of ignorance and in search of visual social security.

European products are frequently visually superior, with discipline imposed by use clearly evident. This is true of automobiles, furniture and household appliances. There are also many European products that are badly designed, but they generally do not reach American markets because of the process of selection and sheer competition. Apparently there are enough visually educated people in Europe to support forms of design more closely related to their everyday life.

But things are changing for the better here in our country too. When people as emotionally involved with automobiles as we are, start a trend towards smaller, less-flashy and more-sensible cars, it is clear evidence of a rising level of consumer judgment.

Such a trend presents a challenge to designers and engineers in all manufacturing fields. They must intensify their efforts to develop an American concept of visual design that reflects actual American living conditions. This design should also reflect the strength of America . . . and its youthfulness. It should and will reflect the best influences of current Northern European and Italian design.

But the starting point is at the grass roots of education. Educators, particularly those concerned with design and engineering, must realize their responsibility to help develop in all of us a new basis for evaluation of manufactured products. Only then can the objectives of designer, producer, marketer and consumer be clarified so that our mass production system can provide values that will reflect the creative greatness already apparent in American engineering.



POINTS

THE QUESTION: *"When Is An Idea Worth Patenting?"*

Dr. Winston E. Kock
Director and General Manager
Research Laboratories
Div, Bendix Aviation Corp

"Possibilities for royalty income . . .

through licensing arrangements in some cases serve as the deciding factors. Surely the protection of a patent affecting a manufacturing process, desirable for use by the patent corporation, is a proper employment of the basic principle of patent laws; so is the matter of protection of the rights of customers.

"While all of the above factors play decisive parts in decisions to apply for patents, the *sine qua non* of all considerations must remain the fact of fundamental value in the idea itself. The Patent Office has long been cluttered with patents issued to cover "rights" on inventions of which the utility was in doubt from the very first. In highly isolated cases, probably, some remote ideas thus covered have served to give their inventor a claim of uncertain value against a later user.

"In the present state of patent law and technological progress such vague claims are seldom likely to be worth the price of their litigation. Too often for such procedures, competing companies uncover other methods or other hardware which will be at least equally effective as that previously patented. The effect, then, of hot competition is to make the coverage of patent law worth its cost only when there is basic value in the idea plus the novelty on which the patent laws insist; and this is as it all was intended and as it should be."

"Save your money . . .

unless the idea is of such character that one can reasonably foresee commercial interest and activity in the product. If the idea is in the nature of specific improvement, easily avoided and with equally desirable alternatives available, save your money. If in doubt as to the commercial acceptability of the idea, contact a reputable manufacturer in the field; you'll get a fair deal, and you will save money.

"When an idea is patentable it does not necessarily follow that the resulting patent is worth the time, effort and money that must be expanded. Ignoring egotistical aspects, the patentee should expect to receive such return on his patent, either in the form of protection or exchange, as would justify the required investment.

"The existence of a valid patent is an effective means of protecting one's investment in engineering time or plant equipment, particularly if the market for the patented product is not large and competition is not desired. The patentee may then protect his product of originality against piracy by excluding others from manufacturing and selling the same product.

"The patent may also be used for exchange purposes, i.e., where a license is granted under the patent in exchange for royalties or license rights under the patents of others required for production or freedom or design."

O. V. Mitchell
Director
RCA Patent Operations
Princeton, NJ.

OF VIEW

Jack Rabinow
President Rabinow Engineering Co Inc
Washington, DC

"The patent system of the United States . . .

is the only good protection for ideas. One should file patents on any idea that one considers worthy enough for submission to a large company. Then the date and the nature of the "beast" is definitely spelled out and, if there should be an argument later, it can be tied down to something concrete. Otherwise, the nature of the idea can be quite vague and, because very few ideas are really completely original, all sorts of cross effects are introduced.

"Having been on both sides of the fence, having submitted many ideas to companies and now having people come to my company with ideas, I feel very strongly that each company must protect itself by demanding a complete release from any obligations in connection with any unsolicited idea. Agreements, such as those required by Chrysler, General Motors, and others, are quite reasonable and I, personally, have known no case where ideas were stolen. I do know, however, of many cases where ideas were submitted, ideas which the companies have worked on themselves in departments far removed from those where the submitted ideas were evaluated. This has caused much trouble and companies should take great pains to make sure that the people who evaluate ideas are fully cognizant of all the work that is being done in the many divisions of their corporations.

"In respect to unpatented ideas, the suggester must take his chances and the only thing he can do, outside of applying for patents, is, perhaps, publish the idea in a magazine. This unfortunately may decrease the value of the idea to the company to which he may later submit it. One just has to pick companies with a reputation for honesty."

"What the inventor will receive . . .

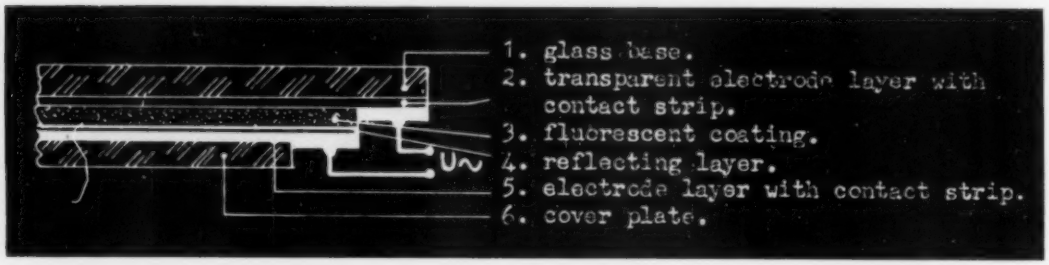
for his efforts will depend largely on two things: (1) How much is it worth to have the right, as far as the inventor is concerned, to use the invention? (2) How valuable is the possibility of excluding imitators long enough to commercialize the invention and perhaps make a profit on it? The independent inventor, therefore, should not patent his idea unless it helps satisfy some need.

"Also, the idea is not worth patenting unless: (a) It is novel. It must not be published or publicly known. An inexpensive novelty search before patenting is a great saver of money and time. (b) It is inventive, i.e. the novel features are not obvious to those of ordinary skill in that field. If the novel advance is a large one, the invention is said to be a broad one. (c) It has been sufficiently worked out so that those in that field can make and use it.

"The table gives probable optimum decisions on patenting. Decisions should be weighted toward patenting if the idea relates to a going business or if market potential is large. The presence of some novelty is assumed."

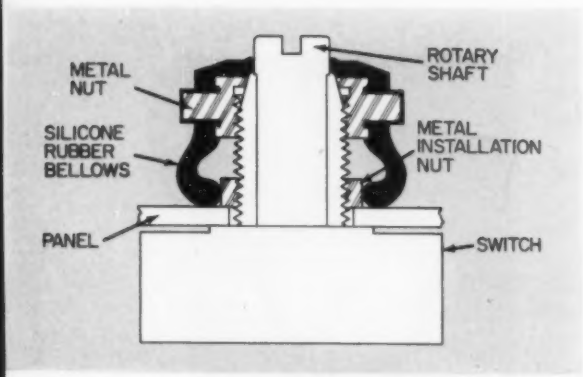
INVENTION	COMMERCIAL USE ANTICIPATED	DECISION
Broad	None	Resolve doubts in favor of patenting
Medium	None	Resolve doubts against patenting
Narrow	None or small	Don't patent
Medium	Small	Patent
Narrow	Substantial	Patent
Little or none	Large	Resolve doubts in favor of patenting

George S. Hastings
Vice-president and Director of Patents
American Machine & Foundry Co


1. glass base.
2. transparent electrode layer with contact strip.
3. fluorescent coating.
4. reflecting layer.
5. electrode layer with contact strip.
6. cover plate.

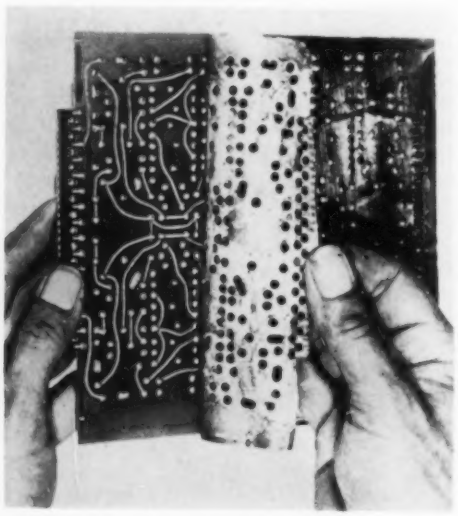
Self-illuminating dials and scales . . .
can be produced from an electroluminescent material, available in rectangular, triangular and circular shapes in various sizes and, for the present, in a green fluorescent color. Panels consist of a layer of fluorescent material between layers of transparent and nontransparent conductive material, sandwiched between two sheets of glass (PE—Sept 15, p 74). Panels, made in Germany, are designed to operate at 110 and 250 v. Under normal indoor operating conditions of 220 v and 50 cps, laminated material is said to have life of a few thousand hours, irrespective of switching frequency. Sizes up to about 3 x 12 in., 0.1 to 0.2 in. thick are offered. Larger sizes may be ordered. Prices, FOB NYC, duty-paid, range from $1521 to $2977 per 1000 units. Delivery is estimated at 2 to 3 mos. **North American Philips Co Inc, 100 E 42nd St, New York 17.**

Circle 11, Reader Service Card



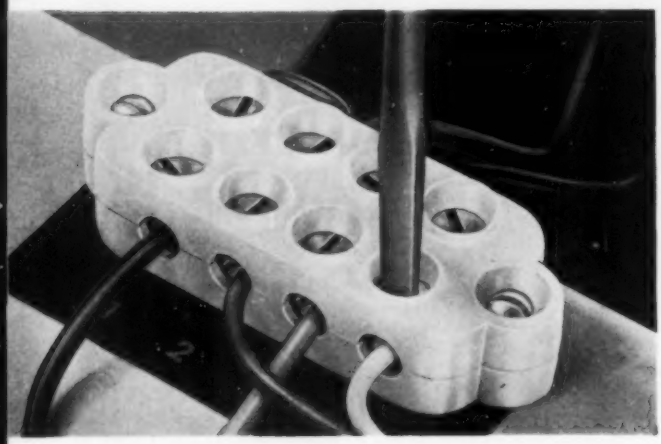
High-pressure shaft seal . . .
for locking rotary devices maintains seal in locked and unlocked positions. Basic design is one-piece silicone rubber bellows molded to metal nut. Bellows seals against panel and an inwardly protruding O-rib seals against rotary shaft. Available to fit all standard thread and shaft sizes. Materials used are said to be unaffected by salt water, acids and ozone. Effective from −160 to 500 F. Price ranges from $1.65 ea in quantities under 100 to 39¢ ea for 5000 or more. 3 to 4-wk delivery. **Automatic & Precision Mfg Co, 252 Hawthorne Ave, Yonkers, NY.**

Circle 12, Reader Service Card



Localized solder coating . . .
in printed circuits is possible with a solder mask that is reported to permit production methods up to 20 times faster than methods now in use. Solder is applied only to areas of electrical contact, preventing waste and short circuits caused by bridging of circuit lines. Eliminates clean-up jobs and allows higher soldering temperatures. Made to specs. About 3-wk delivery. **Miller Dial & Name Plate Co, 4400 N Temple City Blvd, El Monte, Calif.**

Circle 13, Reader Service Card

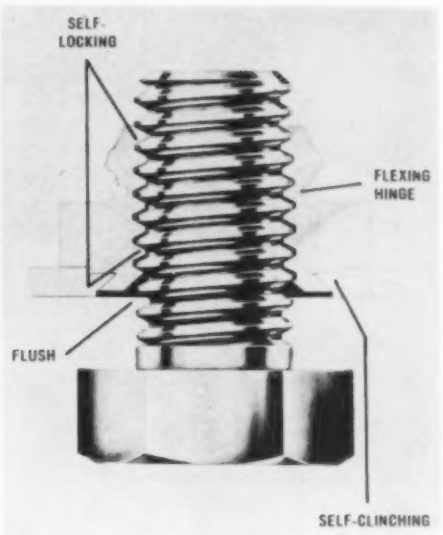


Quarter-turn connects . . .
terminal block without solder, lugs or crimping. Turning a reverse rotary V-cam in each terminal wedges wire ends against inner walls of rectangular bus, locking cam in any position by toggle action. Sloping sides of wedge and busbar wall grip conductor so that all strands carry current. Available with 2 through 20 stations, terminal blocks take wire sizes up to No. 18, handle up to 15 amp and withstand to 220 F. Dielectric strength is 2500 v between terminals, 3000 v from terminal to base. Prices range from about 12¢ to $1.02 each in quantities of 1000 or more. From stock. **Camblock Corp, Div Willor Mfg Corp, 825 Bronx River Ave, New York 72.**

Circle 14, Reader Service Card

Nickel composition plating . . .
of paint-like consistency is brushed, dipped or sprayed on any ferrous metal or copper to provide resistance to corrosion, oxidation and abrasion. Plated mild steel will serve in many applications where only stainless steel could be used. Heated by furnace or induction to 1650 F in an endothermic, exothermic, natural gas or hydrogen reducing atmosphere, coating is fused or brazed into surface of base metal. Thickness varies from 0.0005 to 0.005 in., depending on viscosity of alloy and method of application. Applicable to interiors, such as valves. High luster is possible by using buffing and coloring procedure. Also available in paste form for brazing to produce corrosion and oxidation resistant joints. Another composition adds as much as 75% by weight of amorphous tungsten carbide. Dissolved in a paint and heated to 2050 F in a reducing atmosphere, tungsten carbide precipitates as minute crystals held in a nickel matrix. Resulting 0.0005 to more than 0.007 in. finish fused to base metal is said to show extreme resistance to abrasion, corrosion and oxidation. Hard surface may be ground for cutting tool edges and micro-polished for bearing surfaces, yet is flexible because of nickel matrix. Nickel plating compound lists for $8.58 per lb; with tungsten carbide additive, $35.71 per lb. Immediate delivery on pint, quart, half-gallon and gallon containers. **Todco, PO Box 229, Whittier, Calif.**

Circle 15, Reader Service Card



Self-locking clinching nut . . .
for sheet metal fastening combines two functions in one-piece unit. Employs a clinching ring that causes sheet metal to flow around a back-tapered shank when pressure is applied and locks fastener in sheet with a flush fit on reverse side. Self-locking design is said to retain inherent flexing action of semicircular locking jaws and to maintain effectiveness in severe service and repeated use. Made in steel, with various finishes, and stainless steel in a range of sizes for use with aluminum, magnesium, brass, copper, and cold-rolled steel sheets. **Penn Engineering & Mfg Corp, Doylestown, Penna.**

Circle 16, Reader Service Card

Metal alloy finish . . .
applied in powder form is said to impart to mild steel and other low-cost metals oxidation, corrosion and abrasion-resistance usually found in stainless steels. Thin coating is applied to base metal following fabrication and bonded to base in an hydrogen atmosphere furnace. Three alloys are available, each with a high-nickel base but intended to meet specific service requirements. Furnished as a powder for mixing to desired consistency with cement. May be applied by cold-spraying, dipping or brushing. Coatings vary from 0.002 to 0.010 in. thick, depending on thickness of base metal, part design and anticipated service. Applicable to thin sections, formed members, sheet metal parts and other non-machined components. $10.90 per lb for alloy and binder in quantities under 25 lb. From stock. **Stainless Processing Div, Wall Colmonoy Corp, 19345 John R St, Detroit 3.**

Circle 17, Reader Service Card

Frankly,

we're in the dark . . .

Since we started making glass spheres in 1914, they've been used primarily for reflective paints. You see them in use in highway signs and in the road stripes that glow in the beam of your headlight. Now, with increased capacity, we are looking for new, different uses.

Can you use glass spheres, absolutely uniform in size and quality, in diameters available from .040" to .0025". They possess unusual compressive strength, combined with heat resistance, and electrical insulating properties.

They are the most inexpensive spherical objects to our knowledge. We can even make them moisture resistant.

Do any of their properties suggest a use to you? Samples and all the data we have are yours on request.

POTTERS BROS. INC.

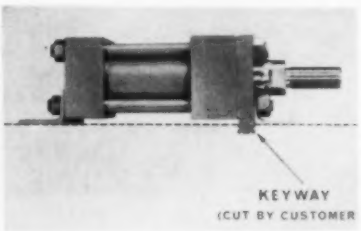
Carlstadt, N. J.

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

TFE films cure at 300 F . . .

or less in two dispersions for application of the lubricating, corrosion-resistant surface to heat-sensitive materials, such as wood, rubber, plastics and light metal. Composed of specially-processed TFE particles suspended in a liquid carrier, dispersion is applied with a spray gun using 35 to 50 psi pressure, followed by air-drying, or infrared or oven-curing, depending on formulation. TFE resins may now be used on industrial machinery to avoid collection of dirt, excessive grease and corrosive elements, as a coating for molds, gaskets and bearing, gas and fuel injector pumps, business machines, garden tools and power mowers. Introductory packages, containing enough material to coat 5000 sq in. of surface, are offered at $4.25 per lb ($4.50 west of the Rockies). $2.60 to $3.10 per lb in quantity. From stock. **Acheson Colloids Co, Port Huron, Mich.**

Circle 18, Reader Service Card



Shear-key cylinder mounting . . .

a modification of a regular mounting style, permits positive alignment of cylinder in a keyway milled into mounting surface and has been adopted as standard for all surface-mounted square cylinders offered by this firm. Majority of thrust is taken by key rather than by mounting bolts, particularly desirable where max operating pressures and short stroke cylinders are used. Key thickness is machined to close tolerances so that keyway can be premilled without affecting fit. **Hannifin Co, Dept 126, 501 S Wolf Rd, Des Plaines, Ill.**

Circle 19, Reader Service Card

4-hp automatic transmission . . .

for small motorized vehicles has one forward and one reverse speed and a neutral position. Input shaft has max capacity at 2400 rpm. Life expectancy is said to be 2600 hr. May be used on vertical shaft engines. Transmission, which weighs 13 lb, is permanently lubricated. **Cizek Mfg & Dist Co, Clutier, Ia.**

Circle 20, Reader Service Card

YOU CAN SAVE TIME, TROUBLE AND COSTS with

Formed Tubes...

★Save Time

We have a huge stock of dies and, when needed, tooling's fast. We also avoid delays by making our own electrically welded steel tubing, sizes from ⅝" to 3" OD.

★Save Trouble

Long, active experience with all tube forming processes and high standards of quality control make sure your orders will be completed *right.*

★Save Costs

It's routine for formed tubes parts to deliver top performance, save weight, cut costs. Steel, copper, brass, aluminum or stainless tubing fabricated in ⅜" OD to 6" OD sizes; from 20 to 11 ga. metal.

Formed Tubes, Inc.
1007 Prairie, Sturgis, Michigan

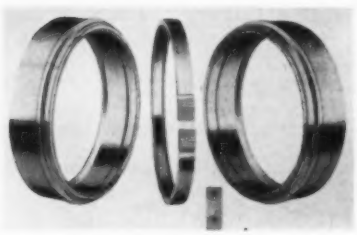
Write for FREE Booklet

Miniature titanium hose . . .
produced from 0.010-in. thick strip and formed into a flexible interlocked tube with 0.50 in. ID is available in commercial quantity. Has 0.115 in. OD. Originally developed as casing for control wires in an atomic reactor, miniature flexible interlocked hose is widely used as casing for capillary tubes in temperature-sensitive controls. Smaller size permits further miniaturization of such control elements. **Flexonics Corp, Maywood, Ill.**

Circle 21, Reader Service Card

Heavier platings . . .
are offered on premium grade brass-plated steel in 24-in. widths and standard grade brass-plated steel in 32-in. widths. Brass finish is protected with a clear baked resin film that does not limit fabricating properties of the metal. Can be formed into many shapes. Available in bright and satin finishes and unpolished, with a heavy brass surface to permit polishing after fabrication. Material cost savings are said to be 25% or more. **American Nickeloid Co, Peru, Ill.**

Circle 22, Reader Service Card



Flush latch coupling . . .
for cylindrical structures assembles with two screws and is said to be as strong as the section it joins. Low cross-section leaves max interior, even in the joint area. Load is distributed equally around the circumference. Permits infinite number of relative positions between sections being joined, without requiring extremely close tolerances. Said to adapt to the use of a seal. Shown disassembled. **Marman Div, Aeroquip Corp, 11214 Exposition Blvd, Los Angeles 64.**

Circle 23, Reader Service Card

Miniature contactor . . .
switches loads to 60 amp at 30 v dc with control signals as small as 2.7 w. SPST, double-break contacts are normally-open or normally-closed. Handles starting surges to 150 amp for 300 millisec. Double-throw version is available with contacts derated to 20 amp. Withstands shocks of 30 g and vibrations of 10 g to 500 cps. Open unit measures $1\frac{3}{32}$ x $\frac{37}{32}$ x $1\frac{1}{32}$ in. and weighs 2 oz. Hermetically sealed unit measures $1\frac{3}{8}$ x $1\frac{7}{16}$ x $2\frac{1}{8}$ in. and weighs 4 oz. **Potter & Brumfield, Inc, Princeton, Ind.**

Circle 24, Reader Service Card

CAMLOC *low cost/light weight*

5F series

Camloc's new small, lightweight 5F Series features high strength-weight ratio plus the quick-operating advantages of a ¼-turn fastener... in a size and weight that offers new design possibilities to original equipment manufacturers! Particularly adaptable to thin materials and miniaturized equipment like airborne electronics, small electro-mechanical and computing devices and communications components. Ideal for attaching lightweight components in "packaged" equipment or for holding access panels on everything from washing machines to radar units.

Offered in many different head styles. Complete specifications will be sent to you on request.

CAMLOC®

CAMLOC FASTENER CORPORATION
62 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.
FORT WORTH OFFICE: 2509 W. BERRY ST., FORT WORTH, TEXAS

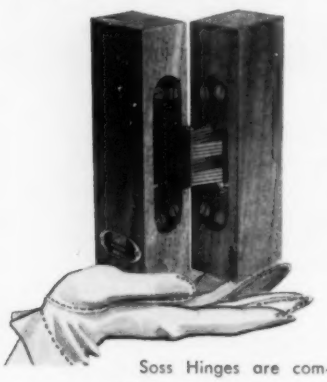
CIRCLE 64 READER SERVICE CARD

Chances are it will be equipped with SOSS INVISIBLE HINGES

"The Hinge That Hides Itself"

Soss Invisible Hinges enable you to do a better job whether you're designing a rocket to the moon or a new typewriter.

NO PROTRUDING HINGE BUTT



Soss Hinges are completely hidden from view when doors or lids are closed. They are the only hinge that creates the flush, smooth streamlined surfaces so necessary for modern design. Unique Soss Hinges are available in a wide size range to meet every requirement.

For complete details, prices and free illustrated catalogue, write today to:

SOSS MANUFACTURING COMPANY

Department 210, P.O. Box 38
Harper Station, Detroit 13, Michigan

SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

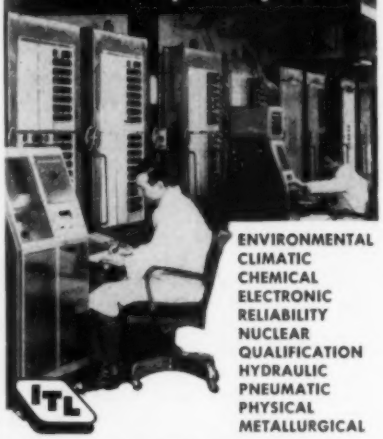
Multiple-section flow valves . . . are rated for pressures to 2000 psi. Provide directional control of pump flow to and from actuating cylinders and hydraulic motors. More than one cylinder or hydraulic motor can be operated simultaneously in a positive sequence regardless of relative loads. Shifting an operating section to provide pressure oil for a cylinder or hydraulic motor results in return oil being ported through next section as pressure oil. Offered in two series, rated 25 and 35 gpm max flow. At max flow, pressure drop is 5 and 10 psi, with 100-F oil and spools centered. Can be supplied with 1 to 10 operating sections. Actuating sections may be assembled in any sequence. Oil leakage and infiltration of foreign matter are minimized by neoprene ring and wiper seals on stem of each operating section. **Sundstrand Hydraulic Div, Sundstrand Machine Tool Co, Rockford, Ill.**

Circle 25, Reader Service Card

Vibration isolation system . . . absorbs vibration through a network of stainless steel cable. Maintains prescribed angular position in relation to unit being isolated, is efficient at any altitude and, in tests, is said to have sustained high g loadings super-imposed on high vibratory loadings. System holds unit rigidly, permitting only straight-line motion, but is completely flexible itself. Vibration can be controlled in high or low frequency by varying cable length, diameter, materials from which it is made or number of suspension loops used, or by varying amounts of prestress. All-metal assembly withstands temperatures from —85 to 500 F. **T R Finn & Co, 200 Central Ave, Hawthorne, NJ.**

Circle 26, Reader Service Card

TESTING
. . . from components to complete systems



ENVIRONMENTAL
CLIMATIC
CHEMICAL
ELECTRONIC
RELIABILITY
NUCLEAR
QUALIFICATION
HYDRAULIC
PNEUMATIC
PHYSICAL
METALLURGICAL

Inland offers a complete range of testing facilities simulating the rugged conditions under which tomorrow's components and products must perform. We welcome your challenge to design and perform specialized tests.

INLAND TESTING LABORATORIES

COOK TECHNOLOGICAL CENTER
6401 OAKTON STREET, MORTON GROVE, ILL.
1482 STANLEY AVENUE, DAYTON, OHIO

CIRCLE 66 READER SERVICE CARD

Here's how you can
MERCHANDISE YOUR ADVERTISING
with these handy 9" by 12" folders

Keep your sales, management and distribution people informed on your advertising. Circulate preprints, reprints, schedules and other material in these folders, and make your advertising dollars work *over and over* for you.

Write for illustrated folder and price list

Promotion Dept. . . . Room 2700
McGraw-Hill Publishing Co., Inc.
330 West 42nd Street, New York 36, N. Y.

INDEX TO ADVERTISERS

This index is published as a convenience to the readers. Every care is taken to make it accurate but PRODUCT ENGINEERING assumes no responsibility for errors or omissions.

Briggs & Stratton Corp.....4th Cover

Camloc Fastener Corp. 33
Cook Electric Co. 34

du Pont de Nemours & Co., (Inc.), E. I., Film Dept. 19

Fafnir Bearing Co. .....3rd Cover
Fluidwick Co. 36
Formed Tubes, Inc. 32

Gamble Brothers, Inc. 4
Garlock Packing Co. 3

Heim Co. 36

International Nickel Co., Inc. ..2nd Cover

Keuffel & Esser Co. 18

Lewellen Mfg. Co. 20
Logansport Machine Co., Inc..... 9

Mallory-Sharon Metals Corp. 14
Milford Rivet & Machine Co. 21
Miniature Precision Bearings, Inc.... 12

New Hampshire Ball Bearings, Inc.. 22

Potters Bros., Inc. 32

Rockwell-Standard Corp., Axle Div... 6

Soss Mfg. Co. 34

PRODUCT ENGINEERING
ADVERTISING SALES STAFF

Atlanta 3 . . . M. H. Miller, 1301 Rhodes-Haverty Bldg., Jackson 3-6951

Boston 16 . . . M. A. Williamson, Jr., 350 Park Square Bldg., Hubbard 2-7160

Chicago 11 . . . Mid-Western Adv. Sales Manager, A. E. Meanor; R. W. Bruley, L. Anderson, 520 N. Michigan Ave., Mohawk 4-5800

Cleveland 13 . . . A. F. Tischer, 1164 Illuminating Bldg., 55 Public Square, Superior 1-7000

Dallas 1 . . . R. T. Wood, 901 Vaughn Bldg., 1712 Commerce St., Riverside 7-5117

Denver 2 . . . John W. Patten, 1740 Broadway, Mile High Center, Alpine 5-2981

Detroit 26 . . . P. B. Robinson, 856 Penobscot Bldg., Woodward 2-1793

Los Angeles 17 . . . Robert Obenour, 1125 West Sixth St., Madison 6-9351

New York 36 . . . B. K. Adams, J. C. Taney, R. G. Wallace, 500 Fifth Ave., Oxford 5-5959

Philadelphia 3 . . . D. G. Jones, K. S. Wildason, 6 Penn Center Plaza, Locust 8-4330

Pittsburgh 22 . . . C. F Leveroni, 1111 Oliver Bldg., Atlantic 1-4707

St. Louis 8 . . . R. W. Bruley, 3615 Olive St., Continental Bldg., Jefferson 5-4867

San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

NEW LITERATURE

Modern Materials–Vol 1

Edited by H. H. Hausner, Academic Press Inc, 111 Fifth Ave, New York 3. 402 pp, 6¼ x 9¼, hardbound. $12.50.

The new specifications of the space age, the nuclear age—and the increasingly finicky consumer—make the designer reach out for new materials, many of them far outside the average stock list only a few short years ago.

This book, one section of which was previewed in PRODUCT ENGINEERING ("Glass and Ceramic Fibers," July 7, p 70), is first of a series planned to provide the designer with up-to-date information he needs. If the current volume is typical, it will certainly succeed in its aim. Indeed, the only criticism of this book might be that it is a bit ahead of date. Several materials, described as though they were fully commercial, are, in fact, still experimental.

Materials covered, in separate chapters, each written by an expert in the field, are synthetic rubber, fibers, insulation papers, ceramics, semiconductors, zirconium and wood.—ARG

How to Supervise People

A. M. COOPER, Industrial Consultant and Training Specialist. Published by McGraw-Hill Book Co Inc, 330 W 42nd St, New York 36. 8 x 5, 250 pp. $4.95

All typical jobs and hiring, discipline, preventing accidents, promoting teamwork, training workers, delegating authority and labor relations are covered. Examples of typical problems and specific solutions now being used in general practice are also included. The book will be useful to supervisors, superintendents and executives. It provides workable principles and methods for building morale, cooperation and productive capacity among subordinates and for developing their own leadership potential.

Drafting Standards For Plastics

Official designation: ASA Y14.11-1958, 22pp, 8½ x 11. ASME, 29 W 39th St, New York 18. $1.50

Answering a long-felt need, and underlining the importance of molded plastics as engineering materials, this new standard covers both mold and part design. It's one of 17 sections of the Drafting Standards Manual.

ENVIRONMENTAL CHAMBERS – Brochure, 28 pp. Describes and illustrates environmental equipment and gives specs, environmental and product applications, and technical-data charts on such subjects as low-temperature refrigerants and specific heat of various substances. Includes 4-color atmosphere and high-altitude charts that indicate standard atmosphere properties. Webber Mfg. Co Inc, PO Box 217, Indianapolis 6.

Circle 1, Reader Service Card

MOBILE TESTING LABS – Brochure ML-100, 16 pp. Illustrated with diagrams of lab layouts and photos of test equipment for mobile units. Gives specs and applications. Soiltest Inc, 4711 W North Ave, Chicago 39.

Circle 2, Reader Service Card

POLYETHYLENE TECHNOLOGY – Handbook, 100 pp. A comprehensive coverage of polyethylene, from the basic chemistry of resins to fabrication of end products. Illustrated with charts, tables and photos. Processing guide contains a minimum of specific information on USI resins, data on which is offered in another brochure. US Industrial Chemicals Co, 99 Park Ave, New York 16.

Circle 3, Reader Service Card

SOLVING FASTENER PROBLEMS– Booklet, 16 pp. Outlines service to solve fastener fit problems. Reviews function, facilities and equipment of each of three new labs. A 7-page appendix of reference material extracts dimensional data from the manufacturer's recently revised handbook. Tells how to enlist lab aid. Standard Pressed Steel Co, Jenkintown, Penna.

Circle 4, Reader Service Card

EXTRUDED SHAPES KIT–is intended to suggest ideas for use in product design. Each 4 x 3-in.-dia round cardboard kit contains assorted aluminum shapes, each about 3 in. long. Dimensions range to 3 in. on a side. 10-day normal delivery is offered on samples from new dies. Midwest Aluminum Corp, 7696 W Michigan Ave, Kalamazoo, Mich.

Circle 5, Reader Service Card

Letterhead Requests Only

Manufacturer who published following literature asked that requests for copies be made on company letterheads.

INDEPENDENT TESTING AND RESEARCH LABS–Directory, 7th edition, 1958. Lists 500 individual services performed by one or more of the labs. Offered to company executives. Requests should be addressed to Executive Secretary, American Council of Independent Laboratories Inc, 4302 East-West Highway, Washington 14, DC.

PERMAWICK

recognized
the world over
as the standard of
quality in sleeve
bearing lubrication!

■ *Write for descriptive brochure*

5319 E. Outer Dr.
Detroit 34, Mich.

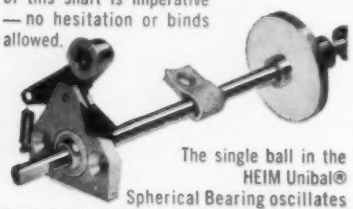
Fluidwick COMPANY

CIRCLE 67 READER SERVICE CARD

HEIM UNIBAL®

Corrects Misalignment All Ways

This shaft is raised 5° to 10° out of alignment to make contact with the film in the Diebold Microfilm Camera. Smooth operation of this shaft is imperative — no hesitation or binds allowed.



The single ball in the HEIM Unibal® Spherical Bearing oscillates freely in all directions, and, depending on the type of mounting, can correct a misalignment of as much as 30°. Available quickly in a wide range of stock sizes at costs far lower than specially made parts.

Send for complete catalog

THE HEIM COMPANY
FAIRFIELD, CONNECTICUT

Publisher's Postscript...

RESPONSIBILITY, and now AUTHORITY

The American economy is changing, and to a large extent you engineers are responsible.

Look at the events of the past two years. Early in 1957 we were riding high. As summer faded into autumn, big minus signs appeared all over the business front. Capital spending contracted, men were laid off, we were heading for a recession, and the coming year looked sour indeed.

We've had six to eight months of shaking down and readjustment. Things are definitely on the upgrade now. But the amazing thing is that while many divisions of industry felt the pinch, there has been little or no letdown in product development. Quite the contrary; producer research and development budgets are expanding and the new products and techniques daily reaching the market place are a major influence for business recovery.

The engineer, and particularly the product design and development engineer, is assuming a place of importance only recently appreciated by economists and bankers and politicians. As technical publishers we have felt this remarkable change very strongly.

The engineer's interests have broadened–he is more critical and more vocal. He's far more likely to write the editor about an article or item we have published. He may ask a question, or take issue with an opinion, or simply offer his own thoughts on a related subject. Our editors currently get more letters from readers in a day than they used to receive in a month.

This is as sure a measure of social responsibility as we know. Engineers and scientists never worried about the applications of their work–that was the executive's or maybe the politician's problem. But now the engineer or scientist gets blamed for decisions and events he never even knew about, in areas he never felt any responsibility for.

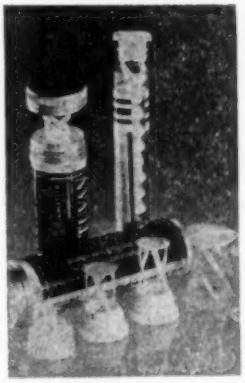
But responsibility can't exist long without some authority to make it stick, and engineers are rapidly picking up the driver's reins. As publishers we forecast this change, and adopted a weekly publishing schedule–the engineer needs more news faster–we broadened our subject coverage to include news reports and articles from all over the world, from all industries, and especially from the research and development centers here and abroad.

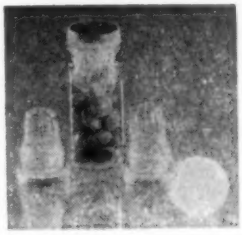
You called for this extension of our services and we're delighted to comply. The editorial staff is better read, more widely traveled, and better informed. They have to be; we serve a far more socially responsible reader. –AH

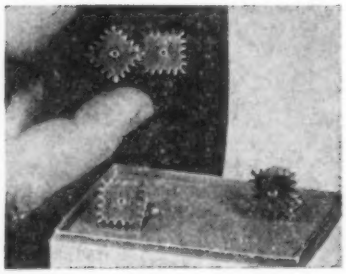
For Your Information (personal)

Plastic springs for gentle pressure

Four unusual cushioning devices, of which two types are pictured here, represent design innovations that might well have application far outside their original field. Developed in France, and now available for sale or manufacture through Pegasus International Corp, One East 53rd St, New York 22, these spring-action devices are specifically aimed at replacing the old cotton plug used to hold pills in place during shipment. But they demonstrate four approaches to a common problem. In addition to the two pictured, there are a three-pronged unit and a lightweight, cylindrical type made of plastic foam. The latter, of course, comes closest to duplicating the cotton plug but, because it can be permanently attached to the bottle closure, presents no difficulties in removal.







Followups

What's the latest in wrist watches, engineered tie clasps, industrial materials for consumer use? Here, as followups on items we've run in the past year, are new developments:

• To the alarm-timers, workable slide rules and electric connectors designed for use as tie clasps (*PE—FYI*, Oct 21 '57; May 19 '58, July 28 '58), Baby Slide Rule Co, Box 9, East Lansing, Mich., adds the meshing gears pictured here with matching cuff links. They're goldplated, priced at $4.75.

• To the array of new wrist watches that ranges from a mechanical (*PE*— Dec 9 '57, p 12) to nuclear, Gruen now brings "the world's thinnest watch"—$\frac{1}{16}$ in. from front to rear, in Executive ($59.50) Majesty ($89.50) and Nobleman ($195.00) models.

• Headed for the dinner table is a material that got its start with missile nose cones: Corning's Pyroceram (*PE*—Mar 17 '58, p 87). Its thermal shock resistance, says Corning, permits design of "all-purpose" cook-and-serve housewares that can go right from the flame to ice water without cracking. Preliminary designs are now being market-tested in New England.

(These are KEY numbers, not page numbers)

NEW LITERATURE Card expires 12/20/58

1 2 3 4 5 6 7 8 9 10

SIGNIFICANT PARTS

11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40

C—COVER

PRODUCTS ADVERTISED

51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68
C3 C4

SPECIAL DATA _____

☐ *Enter my 1-year subscription to PRODUCT ENGINEERING. I will receive 52 weekly issues plus the annual Design Digest Issue.*

PLEASE TYPE OR PRINT

Name .....
Position .....
Company .....
Address .....
City .....Zone ....State .....10/20/58.

Circle key number for more information

(These are KEY numbers, not page numbers)

NEW LITERATURE Card expires 12/20/58

1 2 3 4 5 6 7 8 9 10

SIGNIFICANT PARTS

11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40

C—COVER

PRODUCTS ADVERTISED

51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68
C3 C4

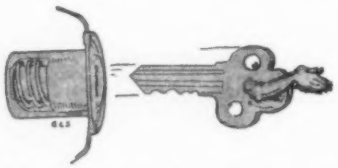
SPECIAL DATA _____

☐ *Enter my 1-year subscription to PRODUCT ENGINEERING. I will receive 52 weekly issues plus the annual Design Digest Issue.*

PLEASE TYPE OR PRINT

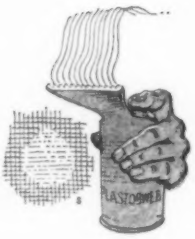
Name .....
Position .....
Company .....
Address .....
City .....Zone ....State .....10/20/58.

WHY DON'T THEY RESEARCH and DEVELOP...

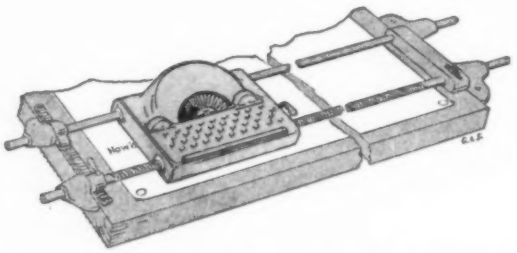


. . . a device that would automatically eject the ignition key of a car when not in use. This would serve as a constant reminder to the driver to take the key with him when leaving the car, thus reducing the number of car thefts, locked-out drivers and accidental startings by children. —N KOURACOS

. . . A screen-mending compound for window and door screens. A suitable plastic dissolved in a volatile solvent and metal colored could be sprayed from an aerosol bomb to make a cobweb type of patch over a hole or tear in the screen. —R S BARNETT



. . . a power-driven line remover for streets and roads. The machine should be capable of sanding, wire-brushing or scraping centerline paints from asphalt or cement highways. Most city and state highway departments are changing traffic patterns often enough to make such a machine very worthwhile. Inadequately removed lines are a hazard to driver and pedestrian alike. —H WINSTON, JR



. . . a portable typewriter suitable for lettering large engineering drawings. The machine might slide on bars which automatically move the machine one space after each letter is typed. No roller is necessary—the type bars swing around and slap the inked ribbon down against the drawing paper. Vertical motion after each line of type might be accomplished by moving the bars relative to the drawing board. This would do fast, neat lettering just where you want it. —F. O. DOLEZAL

Have you a pet subject but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

Use Form On Reverse Side for More Product & Development Data

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

Postage Will Be Paid By Reader Service Department

PRODUCT ENGINEERING
330 WEST 42ND STREET
NEW YORK 36, N. Y

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

Postage Will Be Paid By Reader Service Department

PRODUCT ENGINEERING
330 WEST 42ND STREET
NEW YORK 36, N. Y.

on the world's most powerful known turbojet—

FAFNIR breaks the "bearing barrier!"

Breaking the sound barrier is duck soup for planes equipped with the mighty Pratt and Whitney Aircraft J75, our most powerful production turbojet.

A far tougher "barrier" was the problem of meeting main rotor bearing specifications. Conventional bearing construction couldn't take the loadings and temperatures encountered in such an application. Pratt and Whitney Aircraft looked to Fafnir for help.

Result: custom-designed and custom-built bearings tailor-made for the J75 main rotor mounting. Fabricated of vacuum-melted steel, these bearings feature intricate, split inner ring construction. Tolerances are held to millionths-of-an-inch.

This masterpiece of bearing engineering is another example of how Fafnir research and production facilities are geared to the increasingly complex needs of the aircraft engine and airframe industries. Worth bearing in mind when *you* hit a "bearing barrier!" The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
AIRCRAFT BEARINGS
FIRST at the turning points in aircraft design

Fafnir J75 Main Rotor Bearing, one of 23 Fafnir bearings used in P&WA jets and accessories. Each of these super-precision bearings is exhaustively factory-inspected on special equipment —including many highly refined devices developed by Fafnir for this purpose.

The Pratt and Whitney Aircraft J75 turbojet, Fafnir-equipped, packs 20,000 pounds of thrust.

Designing gasoline-powered equipment to 9 hp?

Save yourself board time! Briggs & Stratton's fully staffed Consulting Engineering Service may already have the answers to problems you're now working on.

Avoid the expense of modifications! Choose from many standard vertical and horizontal shaft models — range 2-9 hp.

Easy starting, rugged construction, lasting dependability. Proven by the millions of Briggs & Stratton engines now in use in homes, on farms, by industry.

Protect your product's performance. Briggs & Stratton maintains a world-wide network of over 10,000 authorized service dealers.

Let the engine be your guide!

Specify Briggs & Stratton 4-Cycle Engines

If you're designing gasoline-powered equipment to 9 hp, you'll be time and money ahead when you power it with a Briggs & Stratton engine.

These dependable 4-CYCLE engines are available in a wide range of models with optional equipment to meet nearly every power requirement. To mention a few of the modifications offered—re-wind and electric starting • flange for direct mounting • built-in gear reduction • automatic choke • fuel pump • manually operated clutch • and an L.P.G. fuel system for many models.

No. 1
in use throughout the world!

Write today for full details —

Briggs & Stratton Corp.
MILWAUKEE 1, WISCONSIN

The leader, too, in automotive locks, keys and related equipment

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES